CALFED
BAY-DELTA
PROGRAM

STORAGE AND CONVEYANCE REFINEMENT STUDY

EVALUATION OF SOUTH OF DELTA OFF-AQUEDUCT STORAGE USING THE CALFED POST-PROCESSING SPREADSHEET OPERATIONS MODEL

INITIAL RESULTS

PRELIMINARY DRAFT

7 March 1997

Initial Sensitivity Evaluation of Operational Parameters and Storage Capacities Using the CALFED Post-Processing Operations Model

South of Delta Off-Aqueduct Storage Facilities

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South of Delta Off-Aqueduct Storage Facilities

OVERVIEW OF EVALAUTION

Introduction

The CALFED Post-Processing Operations Model was developed to evaluate the sensitivity of various operational parameters and physical capacities of potential new storage and conveyance facilities in terms of 1) environmental water supply benefits and 2) urban and agricultural water supply benefits. This relatively simplistic model is suitable for analyzing the effects of various storage operation rules and goals, identifying critical external constraints, and providing initial refinement to the ranges of storage and conveyance capacities to be considered in future studies. Information developed from this evaluation will be used to guide more detailed studies, including DWRSIM system operation studies.

The spreadsheet-based CALFED Post-Processing Operations Model uses the results of DWRSIM benchmark operation studies as input. New storage and conveyance facility operations are simulated assuming surplus water supplies, unused conveyance facility capacities, and unmet urban and agricultural demands as defined by DWRSIM and user-defined environmental demands. While this model provides useful initial information, two important limitations must be considered when interpreting model results. First, the CALFED Post-Processing Operation Model simulations do not integrate the operations of new storage and conveyance components with operation of existing facilities. Second, the model simulations do not dynamically model Delta processes. While these simulations are constrained by surplus Delta water, Delta export limitations, and available physical capacities as defined by DWRSIM, specific in-Delta flows and salinities are not evaluated. Future DWRSIM and Delta hydrodynamic modeling studies must be used to assess the impacts of both of these limitations.

In the evaluation documented in this report, the CALFED Post-Processing Operations Model was used to assess the sensitivity of various operational parameters and storage capacities of south of Delta off-aqueduct storage facilities. After completing sensitivity analyses of individual operational parameters (e.g. level of demand and storage carryover requirements), sets of parameters were chosen for two operation goals. These goals, termed Normal Period Supply Operation and Dry Period Supply Operation in this report, are generally mutually exclusive. Storage operations that target maximum supplies over normal long-term hydrologic periods usually result in limited supplies available in extended dry periods. On the other hand, storage operations that target maximum supplies in extended dry periods general have a high cost in terms of reduced supplies over normal long-term hydrologic periods.

Because the capacity of Banks Pumping Plant, the State Water Project Delta pumping facility, has a significant affect on potential operation of south of Delta off-aqueduct storage facilities, two capacities were considered in this evaluation. Under the first condition, existing Banks Pumping Plant capacity is assumed. Under the second condition, an expanded Banks Pumping Plant capacity as proposed in the Department of Water Resources South Delta Improvements Plan is assumed.

Water supply benefits were evaluated for storage capacities ranging from 0 to 3.0 maf for each of the four conditions defined by the two operation goals under two Banks Pumping Plant capacities. The results of this evaluation may be used to appraise relative relationships between benefits and storage capacities; absolute quantities of benefits must be confirmed by more detailed modeling.

Two parallel evaluations were completed for south of Delta off-aqueduct storage facilities dedicated exclusively to 1) environmental water supply benefits and 2) agricultural and urban benefits. These two evaluations are summarized in the following sections of this report. Future evaluations using the CALFED Post-Processing Operations Model will consider the effects of joint storage operations for both environmental water supply benefits and agricultural and urban water supply benefits.

Summary Results

Results of the two parallel evaluations for environmental water supply operations and agricultural and urban water supply operations are summarized in this section. More detailed results are provided in the following sections of this report.

Environmental Water Supply Benefits

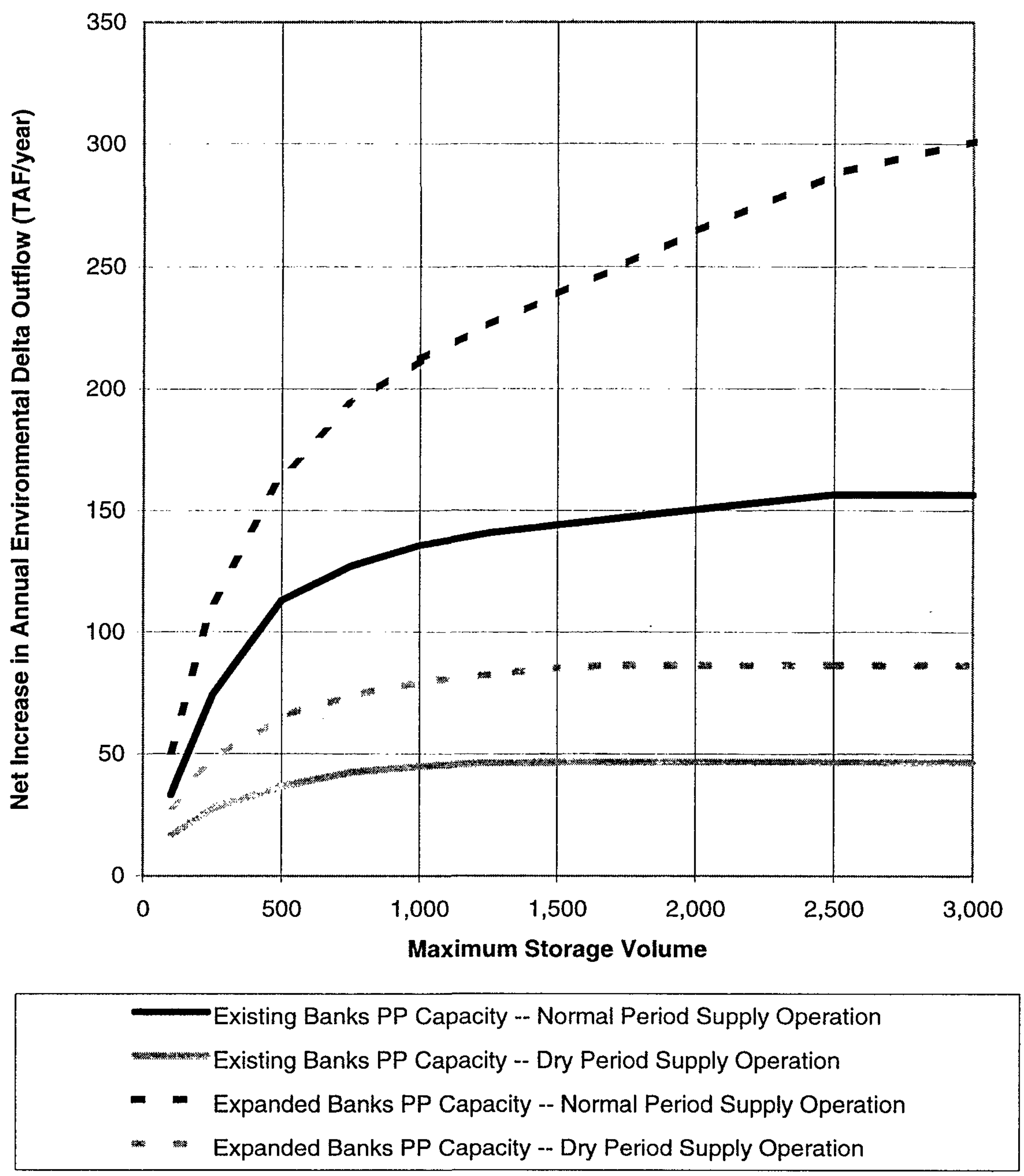
In this evaluation, a minimum Delta outflow target of 12,000 cfs for the months of January through June is used as a surrogate for environmental water demands. Because the CALFED Post-Processing Operations Model uses a monthly time step, more detailed evaluation of flows is not possible with this tool. However, in actual operation, the volume of water released from storage towards the 12,000 cfs target might be used to create higher pulses of flow for shorter durations, if this operation was deemed more environmentally beneficial.

Using this target minimum Delta outflow surrogate approach, environmental water supply benefits are measured in this evaluation by averaging monthly flow rates up to a maximum of 12,000 cfs for January through June of each water year. Any flow above 12,000 cfs is not considered. Note that the result of this computation is significantly lower than and not comparable to *total* average annual Delta outflow. For simplicity in this evaluation, this average of January through June Delta outflows up to 12,000 cfs is termed *Environmental Delta Outflow.*

Summary results of this initial evaluation are presented in Figures 1 and 2. These charts depict net increases in 71-Year Average Annual Environmental Delta Outflow and Minimum Annual Environmental Delta Outflow, respectively, under the four operation conditions described earlier for storage volumes ranging from 0 to 3.0 maf. These two measures of Environmental Delta Outflow reflect Normal Period and Dry Period water supply benefits, respectively.

Figure 1

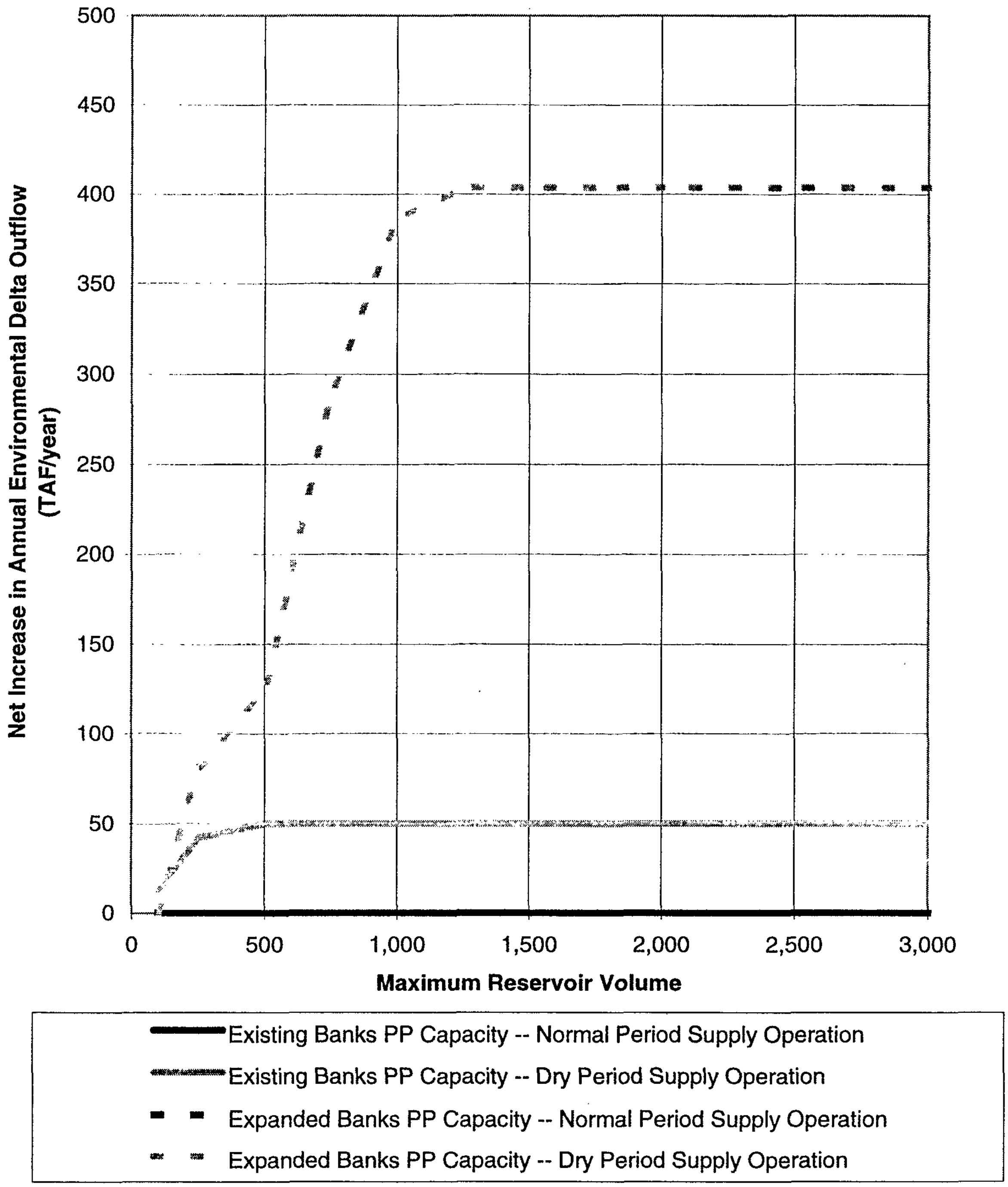
South of Delta Off-Aqueduct Storage
Net increase in 71-Year Average Environmental
Delta Outflow versus Maximum Storage Volume



SE_RVSM.XLS: Net 71-Yr Avg Chart

Figure 2

South of Delta Off-Aqueduct Storage
Net Increase in Minimum Annual Environmental Delta Outflow versus Maximum Storage Volume



SE_RVSM.XLS: Net Min Annual Chart

As evidenced by the ranges between the curves of Figures 1 and 2, this initial evaluation demonstrates the importance of operating assumptions on the outcome of water supply evaluations. As expected, normal period supply operations maximize average annual water supplies, but provide little benefit during extended dry periods. On the other hand, dry period supply operations allow for carrying water in storage through extended dry periods, at a very high cost in average annual yield.

This initial evaluation indicates that with existing Banks Pumping Plant capacity only minor environmental water supply benefits might be derived from new south of Delta storage facilities. Potential net benefit in Minimum Annual Environmental Delta Outflow is limited to about 50 taf and is achieved with a maximum storage capacity of 500 taf. The maximum net benefit in 71-Year Average Annual Environmental Delta Outflow with this 500 taf maximum storage capacity is 110 taf. Minor increases in 71-Year Average Annual Environmental Delta Outflow are possible with larger maximum storage capacities.

More significant environmental benefits might be derived from new south of Delta storage facilities with an expanded Banks Pumping Plant capacity. Potential net benefit in Minimum Annual Environmental Delta Outflow could exceed 400 taf with a maximum storage capacity of 1.25 maf. A net benefit in 71-Year Average Annual Environmental Delta Outflow of about 230 taf is possible with this storage capacity. Additional 71-Year Average Annual Delta Outflow could be achieved with additional storage capacity, with a net benefit in 71-Year Average Annual Environmental Delta Outflow of 310 taf with a 3.0 maf storage capacity.

Agricultural and Urban Water Supply Benefits

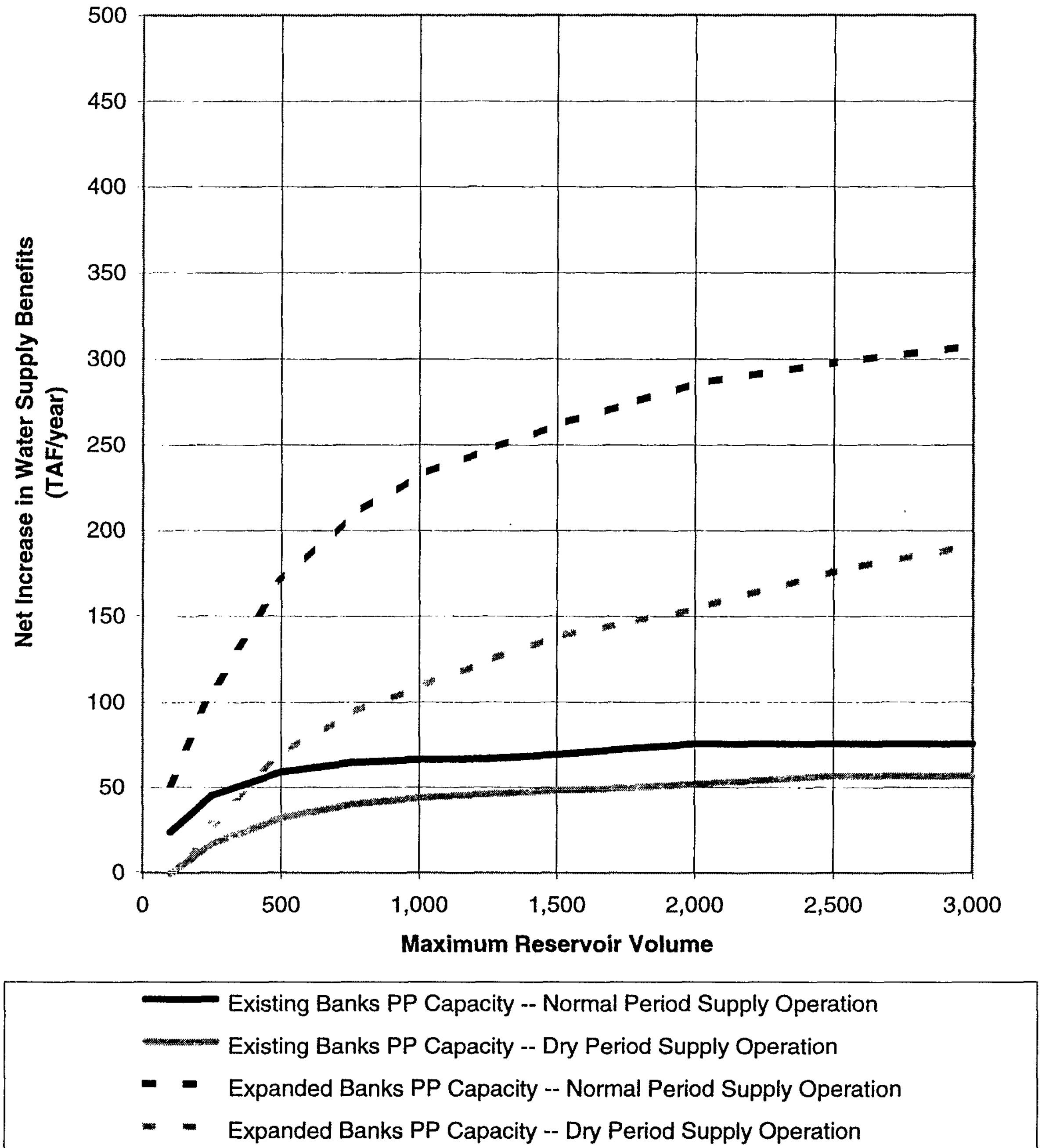
In this evaluation, south of Delta SWP and CVP demands were used as a surrogate for agricultural and urban water supply demands. In actual practice, agricultural and urban water supply benefits from south of Delta storage might be designated to a subset of SWP and CVP users, other south of Delta agricultural and urban users, or upstream of Delta users through a water exchange program.

Summary results of this initial evaluation are presented in Figures 3 and 4. These charts depict net increases in 71-Year Average Annual Agricultural and Urban Water Supply Benefits and Minimum Annual Agricultural and Urban Water Supply Benefits, respectively, under the four operation conditions described earlier for storage volumes ranging from 0 to 3.0 maf. The charts allow comparison of the range of potential benefits under various Banks Pumping Plant capacities, operational goals, and storage capacities.

This initial evaluation indicates that with existing Banks Pumping Plant capacity only minor agricultural and urban water supply benefits might be derived from new south of Delta storage facilities. The net increase in 71-Year Average Annual Agricultural and Urban Water Supply Benefits with a 1.5 maf maximum storage capacity is 70 taf. Only minor increases in 71-Year Average Annual Agricultural and Urban Water Supply Benefits are possible with larger maximum storage capacities. Potential net increase in Minimum Annual Agricultural and Urban Water Supply Benefits is about 250 taf and is achieved with this same maximum storage capacity of 1.5 maf.

Figure 3

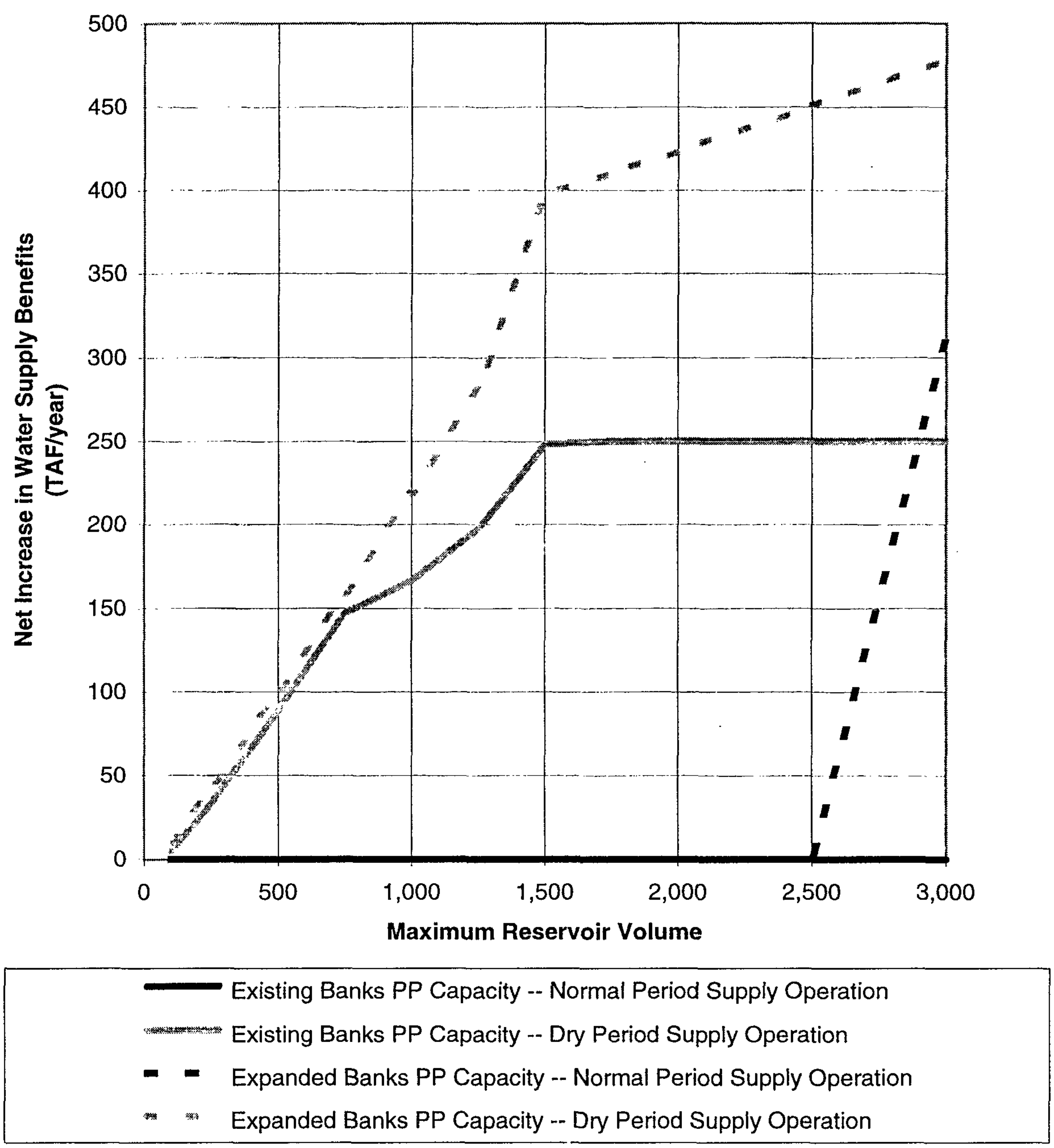
South of Delta Off-Aqueduct Storage
Net increase in 71-Year Average Ag & Urban Water Supply Benefits versus Maximum Storage Volume



SA_RVSM.XLS: Net 71-Yr Avg Chart

Figure 4

South of Delta Off-Aqueduct Storage
Net Increase in Minimum Annual Ag & Urban Water Supply Benefits
versus Maximum Storage Volume



SA_RVSM.XLS: Net Min Annual Chart

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More significant agricultural and urban water supply benefits might be derived from new south of Delta storage facilities with an expanded Banks Pumping Plant capacity. A net increase in 71-Year Average Annual Agricultural and Urban Water Supply Benefits of about 290 taf is possible with a storage capacity of 2.0 maf. Minor additional 71-Year Average Annual Delta Outflow could be achieved with additional storage capacity, with a net benefit of 310 taf with a 3.0 maf storage capacity. Potential net benefit in Minimum Annual Agricultural and Urban Water Supply Benefits could exceed 420 taf with a maximum storage capacity of 2.0 maf.

Initial Sensitivity Evaluation of Operational Parameters and Storage Capacities Using the CALFED Post-Processing Operations Model

South of Delta Off-Aqueduct Storage Facilities

ENVIRONMENTAL WATER SUPPLY EVALUATION

Introduction

Environmental water supply benefits from new south of Delta storage facilities would be achieved by instituting an exchange with south of Delta agricultural and urban water users. Under this arrangement, water would be released from new storage facilities to meet existing downstream agricultural and urban water supply needs. In return, agricultural and urban water users would forego a like amount of exports at the Delta. The capacity of the new storage facility, rules governing diversions into storage, and operational goals (e.g. maximum normal period supply or maximum dry period supply) all affect the magnitude of potential environmental water supply benefits.

The CALFED spreadsheet operations model was used to evaluate effects of various operational rules and physical capacities of new south of Delta storage facilities on potential environmental water supply benefits. A sensitivity analysis was conducted by individually exercising the operational parameters through reasonable ranges with a set south of Delta maximum storage capacity of 2.0 maf and inflow/outflow conveyance capacities of 3,500 cfs, devoted exclusively to environmental water supply. Information from this phase of the evaluation was then used to develop four sets of parameters which collectively bracket the range of potential operations. These four sets of parameters define two operational goals implemented under two external conditions.

The first operational goal modeled is to maximize supplies over normal hydrologic periods. This goal is achieved by imposing no storage carryover requirement and releasing water from storage whenever unmet demand exists. A by-product of this type of operation is that supplies in storage are often depleted when entering critically dry periods. The second operational goal is to maximize supplies in the driest years of normal hydrologic sequences. This goal is achieved by imposing carryover requirements or limiting the amount of water delivered from storage in any given year. While this type of operation usually results in relatively larger quantities of water in storage for use during extended dry periods, overall long-term water deliveries are diminished.

The two external conditions considered in this evaluation address the capacity of Banks Pumping Plant, the State Water Project Delta pumping facility. Capacity of Banks Pumping Plant significantly affects storage operations under both the normal period supply and dry period supply operational goals considered in this evaluation. Under the first external condition, existing Banks Pumping Plant capacity is assumed. Under the

Table SE-1
Bracketing Operational Conditions

Condition	Description
A	Existing Banks PP Capacity -- Normal Period Supply Operation. This condition assumes that diversions to south of Delta storage are limited by existing Banks Pumping Plant capacity and that the storage facility is operated to provide maximum supplies over normal hydrologic periods.
B	Existing Banks PP Capacity -- Dry Period Supply Operation. This condition assumes that diversions to south of Delta storage are limited by existing Banks Pumping Plant capacity and that the storage facility is operated to provide maximum supplies in critically dry years.
C	Expanded Banks PP Capacity -- Normal Period Supply Operation. This condition assumes that diversions to south of Delta storage are supplemented by an increased Banks Pumping Plant capacity as proposed in the Department of Water Resources Interim South Delta Improvement Plan and that the storage facility is operated to provide maximum supplies over normal hydrologic periods.
D	Expanded Banks PP Capacity -- Dry Period Supply Operation. This condition assumes that diversions to south of Delta storage are supplemented by an increased Banks Pumping Plant capacity as proposed in the Department of Water Resources Interim South Delta Improvement Plan and that the storage facility is operated to provide maximum supplies in critically dry years.

Table SE-2
Statistical Measures of Environmental Delta Outflow

Measure	Description
1	71-Year Average Annual Environmental Delta Outflow. Annual average over the historical hydrologic sequence used in the model simulations.
2	1928-34 Critical Dry Period Average Annual Environmental Delta Outflow. Annual average over the seven year critical dry period.
3	Average Dry Year Environmental Delta Outflow. Annual average over the sixteen water years classified as dry years within the 71-year hydrologic sequence.
4	Average Critically Dry Year Environmental Delta Outflow. Annual average over the eleven water years classified as critically dry years within the 71-year hydrologic sequence.
5	Minimum Annual Environmental Delta Outflow. The minimum annual quantity that occurs over the 71-year hydrologic sequence.

second external condition, an expanded Banks Pumping Plant capacity as proposed in the Department of Water Resources South Delta Improvements Plan is assumed. The four operation conditions defined by the two operational goals under these two external conditions are described in Table SE-1.

Once developed, parameters sets for each of the four operation conditions were input to the CALFED spreadsheet operations model. Potential environmental water supply benefits were evaluated for maximum storage capacities ranging from 100 taf to 3.0 maf. In this evaluation, a minimum Delta outflow target of 12,000 cfs for the months of January through June is used as a surrogate for environmental water demands. Because the CALFED spreadsheet operations model uses a monthly time step, more detailed evaluation of flows is not possible with this tool. However, in actual operation, the volume of water released from storage towards the 12,000 cfs target might be used to create higher pulses of flow for shorter durations, if this operation was deemed more environmentally beneficial.

Using this target minimum Delta outflow surrogate approach, environmental water supply benefits are measured in this evaluation by averaging monthly flow rates up to a maximum of 12,000 cfs for January through June of each water year. Any flow above 12,000 cfs is not considered. Note that the result of this computation is significantly lower than and not comparable to *total* average annual Delta outflow. For simplicity in this evaluation, this average of January through June Delta outflows up to 12,000 cfs is termed *Environmental Delta Outflow*. Five statistical measures of Environmental Delta Outflow are included in this analysis, as described in Table SE-2.

Environmental water supply benefits, as described by these five measures, were estimated for each of the four sets of operation conditions over the range of maximum storage volumes. While this information should not be considered definitive, this evaluation illustrates the potential for environmental benefits from south of Delta storage facilities and the effects of various operation conditions. The information developed in this evaluation may be used to provide an initial refinement of the range of storage volumes of potential south of Delta storage facilities which should be considered in future studies.

Summary

This evaluation provides initial quantitative information on environmental water supply benefits that might be provided by new south of Delta storage facilities. Additional information on water quality benefits, interaction with agricultural and urban water supply opportunities, interactions with other potential new storage and conveyance facilities, costs of new storage facilities, and environmental acceptability of new storage facilities must all be considered in a further refinement of environmental water storage facilities.

Summary results of this initial evaluation are presented in Figures SE-1 and SE-2. These charts depict net increases in 71-Year Average Annual Environmental Delta Outflow and Minimum Annual Environmental Delta Outflow, respectively, under the four operation conditions described in Table SE-1 for storage volumes ranging from 0 to 3.0 maf. The charts allow comparison of the range of potential benefits under various Banks Pumping Plant capacities, operational goals, and storage capacities.

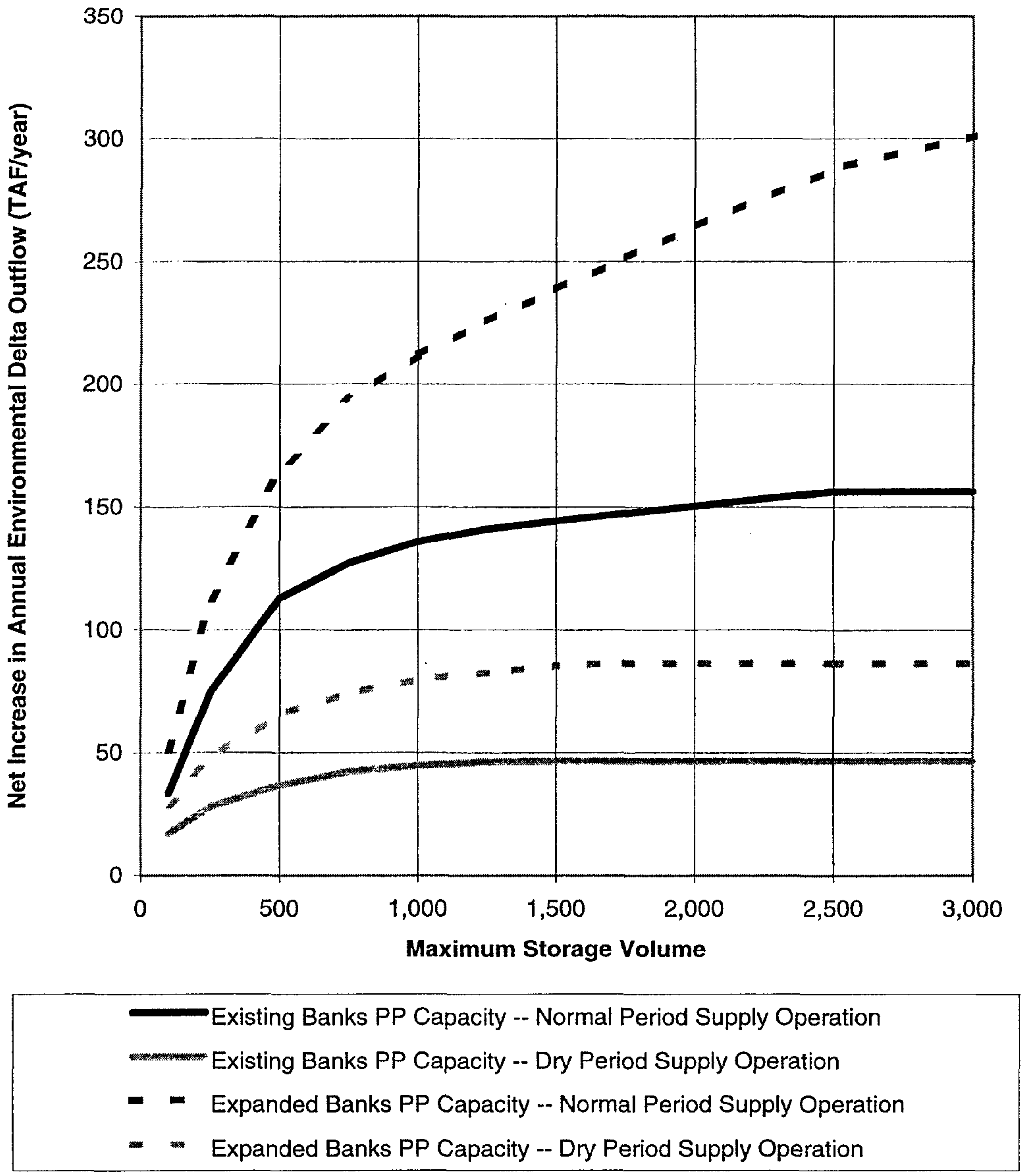
As evidenced by the ranges between the curves of Figures SE-1 and SE-2, this initial evaluation demonstrates the importance of operating assumptions on the outcome of water supply evaluations. As expected, normal period supply operations maximize average annual water supplies, but provide little benefit during extended dry periods. On the other hand, dry period supply operations allow for carrying water in storage through extended dry periods, at a very high cost in average annual yield. This is most vividly illustrated by comparing the curves representing Existing Banks Pumping Plant Capacity -- Dry Period Supply Operation in Figures SE-1 and SE-2. In both figures, at a storage volume of 1.0 maf the Existing Banks Pumping Plant Capacity -- Dry Period Supply Operation reaches an asymptotic net increase of about 50 taf. However, with the same 1.0 maf storage capacity, the Existing Banks Pumping Plant Capacity -- Normal Period Supply Operation yields a net increase of about 140 taf in the 71-Year Average Annual Environmental Delta Outflow compared to a 0 taf net increase for the Minimum Annual Environmental Delta Outflow.

This initial evaluation indicates that with existing Banks Pumping Plant capacity only minor environmental water supply benefits might be derived from new south of Delta storage facilities. Potential net benefit in Minimum Annual Environmental Delta Outflow is limited to about 50 taf and is achieved with a maximum storage capacity of 500 taf. The maximum net benefit in 71-Year Average Annual Environmental Delta Outflow with this 500 taf maximum storage capacity is 110 taf. Minor increases in 71-Year Average Annual Environmental Delta Outflow are possible with larger maximum storage capacities.

More significant environmental benefits might be derived from new south of Delta storage facilities with an expanded Banks Pumping Plant capacity. Potential net benefit in Minimum Annual Environmental Delta Outflow could exceed 400 taf with a maximum storage capacity of 1.25 maf. A net benefit in 71-Year Average Annual Environmental Delta Outflow of about 230 taf is possible with this storage capacity. Additional 71-Year Average Annual Delta Outflow could be achieved with additional storage capacity, with a net benefit in 71-Year Average Annual Environmental Delta Outflow of 310 taf with a 3.0 maf storage capacity.

Figure SE-1

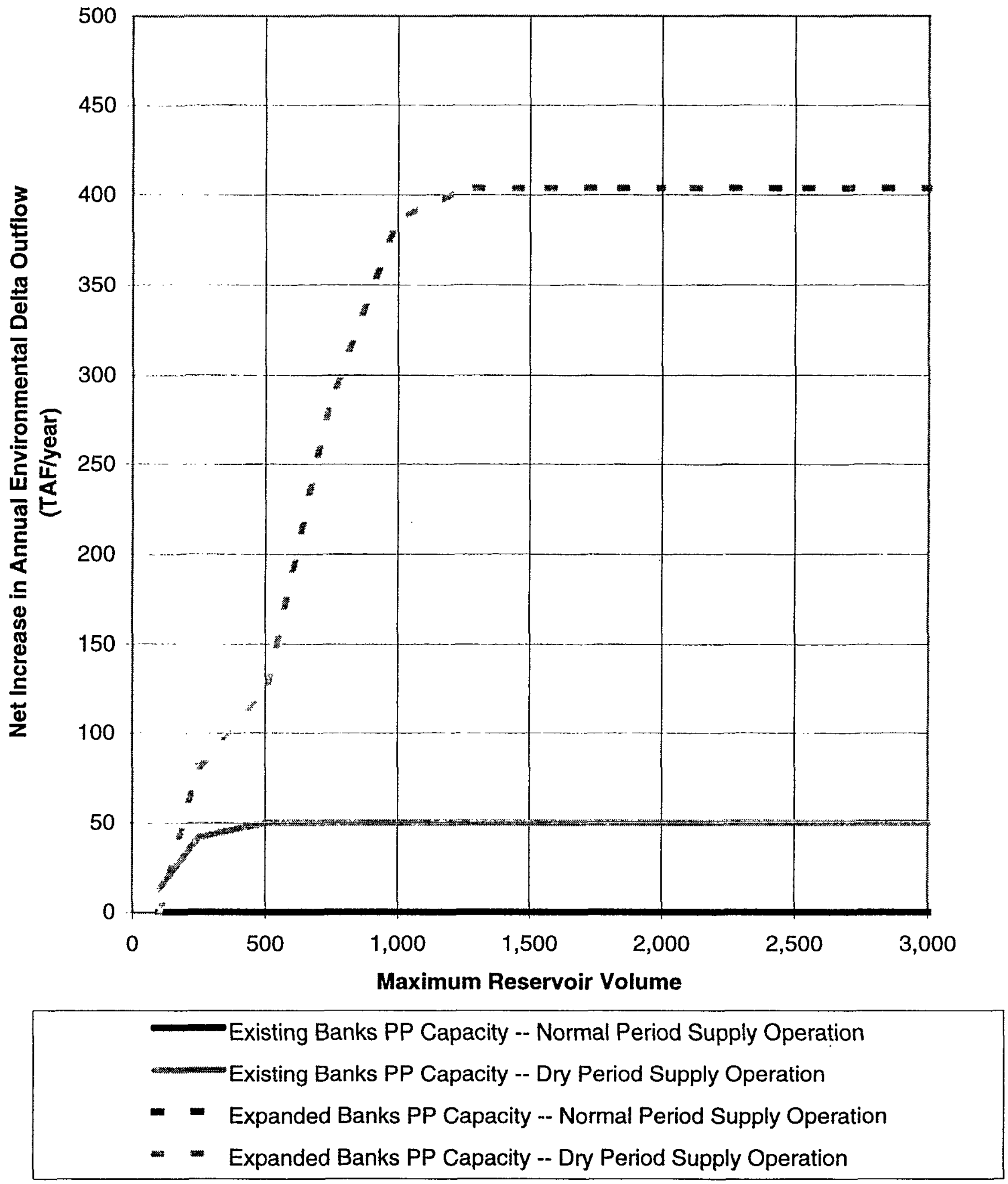
South of Delta Off-Aqueduct Storage
Net increase in 71-Year Average Environmental
Delta Outflow versus Maximum Storage Volume



SE_RVSM.XLS: Net 71-Yr Avg Chart

Figure SE-2

South of Delta Off-Aqueduct Storage Net Increase in Minimum Annual Environmental Delta Outflow versus Maximum Storage Volume



SE_RVSM.XLS: Net Min Annual Chart

Environmental Water Supply Benefits versus Storage Carryover Factor

Background

The storage carryover factor is an operational parameter designed to provide a means of reserving water supplies for use throughout extended dry periods. In practice, complex reservoir storage carryover rules may be devised to take into account runoff forecasting, variable demand, current storage volume, and other criteria. In this model, a simple storage carryover function has been included which allows the user to set a fraction of end-of-September storage from the previous water year that will be required to remain in storage at the end of the current water year. For example, if 100 taf are in storage at the end of September of the current year, with a storage carryover factor of 70 percent, the storage facility must maintain at least 70 taf by the end of September of the following year. While implementing conservative carryover rules in reservoir operations will increase available supplies during dry periods, total deliveries over normal hydrologic periods will be reduced in comparison to more aggressive reservoir operations.

Model Runs

Storage carryover factors ranging from 0 to 70 percent were varied in a set of model runs to evaluate effects on water supply benefits 1) with and without expanded Banks Pumping Plant capacity, 2) with varied targets for minimum Delta outflow, and 3) with varied unmet demand target factors (described below). These model runs are described in Table SE-3 and summary results are displayed in Table SE-4. For comparability, all results are measured using the Environmental Delta Outflow criteria (average of January through June monthly Delta outflows up to 12,000 cfs) described previously.

Evaluation -- Sensitivity Analysis

Varying the storage carryover factor results in negligible effects for all runs with existing Banks Pumping Plant capacity. Less than 1-percent differences are seen in 71-year average and minimum annual Environmental Delta Outflow throughout the range of storage carryover factors evaluated. Charts displaying the five measures of Environmental Delta Outflow described in Table SE-2 plotted versus storage carryover factor for the existing Banks Pumping Plant capacity condition are shown in Figures SE-3 through SE-6.

Minor effects occur in runs with expanded Banks Pumping Plant capacity. Less than 1-percent decreases in 71-Year Average Annual Environmental Delta Outflow and a maximum 5-percent increase in Minimum Annual Environmental Delta Outflow are seen while varying storage carryover factors between 0 percent and 70 percent. A 7-percent *decrease* occurs in Minimum Annual Environmental Delta Outflow while increasing the storage carryover factor from 0 to 70 percent, with Delta outflow target set at 9,000 cfs and unmet demand factor set at 50 percent. Plots of the five measures of Environmental Delta Outflow versus storage carryover factor for the expanded Banks Pumping Plant capacity condition are shown in Figures SE-7 through SE-10.

The storage carryover factor has a minimal effect in reserving water supplies through extended dry periods when there are high levels of environmental demand in comparison to potential reservoir yield. The largest effects are produced when target Delta outflow is reduced.

Table SE-3

South of Delta Off-Aqueduct Storage
Model Runs for Evaluation of Storage Carryover Factor

Run Results Workbook	Evaluation Workbook	Model Run Identifiers	Storage Carryover Factor	Common Assumptions
OUT_SO1.XLS	SE_CO1.XLS	SE001	0%	2.0 maf Maximum Storage Volume
		SE002	10%	3,500 cfs Inflow/Outflow Capacity
		SE003	20%	Existing Banks PP Capacity
		SE004	30%	Jan-Jun Outflow Target = 12,000 cfs
		SE005	40%	Unmet Demand Target Factor = 100%
		SE006	50%	
		SE007	60%	
		SE008	70%	
OUT_SO1.XLS	SE_CO2.XLS	SE009	0%	2.0 maf Maximum Storage Volume
		SE010	10%	3,500 cfs Inflow/Outflow Capacity
		SE011	20%	Existing Banks PP Capacity
		SE012	30%	Jan-Jun Outflow Target = 9,000 cfs
		SE013	40%	Unmet Demand Target Factor = 100%
		SE014	50%	
		SE015	60%	
		SE016	70%	
OUT_SO1.XLS	SE_CO3.XLS	SE017	0%	2.0 maf Maximum Storage Volume
		SE018	10%	3,500 cfs Inflow/Outflow Capacity
		SE019	20%	Existing Banks PP Capacity
		SE020	30%	Jan-Jun Outflow Target = 12,000 cfs
		SE021	40%	Unmet Demand Target Factor = 50%
		SE022	50%	
		SE023	60%	
		SE024	70%	
OUT_SO1.XLS	SE_CO4.XLS	SE025	0%	2.0 maf Maximum Storage Volume
		SE026	10%	3,500 cfs Inflow/Outflow Capacity
		SE027	20%	Existing Banks PP Capacity
		SE028	30%	Jan-Jun Outflow Target = 9,000 cfs
		SE029	40%	Unmet Demand Target Factor = 50%
		SE030	50%	
		SE031	60%	
		SE032	70%	
OUT_SO1.XLS	SE_CO5.XLS	SE033	0%	2.0 maf Maximum Storage Volume
		SE034	10%	3,500 cfs Inflow/Outflow Capacity
		SE035	20%	SDI Banks PP Capacity
		SE036	30%	Jan-Jun Outflow Target = 12,000 cfs
		SE037	40%	Unmet Demand Target Factor = 100%
		SE038	50%	
		SE039	60%	
		SE040	70%	
OUT_SO1.XLS	SE_CO6.XLS	SE041	0%	2.0 maf Maximum Storage Volume
		SE042	10%	3,500 cfs Inflow/Outflow Capacity
		SE043	20%	SDI Banks PP Capacity
		SE044	30%	Jan-Jun Outflow Target = 9,000 cfs
		SE045	40%	Unmet Demand Target Factor = 100%
		SE046	50%	
		SE047	60%	
		SE048	70%	
OUT_SO1.XLS	SE_CO7.XLS	SE049	0%	2.0 maf Maximum Storage Volume
		SE050	10%	3,500 cfs Inflow/Outflow Capacity
		SE051	20%	SDI Banks PP Capacity
		SE052	30%	Jan-Jun Outflow Target = 12,000 cfs
		SE053	40%	Unmet Demand Target Factor = 50%
		SE054	50%	
		SE055	60%	
		SE056	70%	
OUT_SO1.XLS	SE_CO8.XLS	SE057	0%	2.0 maf Maximum Storage Volume
		SE058	10%	3,500 cfs Inflow/Outflow Capacity
		SE059	20%	SDI Banks PP Capacity
		SE060	30%	Jan-Jun Outflow Target = 9,000 cfs
		SE061	40%	Unmet Demand Target Factor = 50%
		SE062	50%	
		SE063	60%	
		SE064	70%	

Table SE-4

South of Delta Off-Aqueduct Storage
Environmental Delta Outflow vs. Storage Carryover Factor
Under Various Operational Conditions[1]
(Values in thousands of acre-feet)

Run Identifiers:	SE001	SE002	SE003	SE004	SE005	SE006	SE007	SE008	Minimum Value	Maximum Value	Percent Difference
Storage Carryover Factor	0%	10%	20%	30%	40%	50%	60%	70%			
71-Year Average	3,912	3,911	3,910	3,909	3,907	3,904	3,900	3,894	3,894	3,912	0.5%
1928-34 Dry Period Average	3,281	3,281	3,281	3,280	3,280	3,280	3,279	3,278	3,278	3,281	0.1%
Dry Year Average	3,716	3,713	3,709	3,705	3,700	3,694	3,685	3,668	3,668	3,716	1.3%
Critically Dry Year Average	3,083	3,079	3,074	3,069	3,061	3,050	3,041	3,039	3,039	3,083	1.4%
Minimum Annual	2,410	2,410	2,411	2,412	2,414	2,417	2,420	2,422	2,410	2,422	0.5%

Run Identifiers:	SE009	SE010	SE011	SE012	SE013	SE014	SE015	SE016	Minimum Value	Maximum Value	Percent Difference
Storage Carryover Factor	0%	10%	20%	30%	40%	50%	60%	70%			
71-Year Average	3,888	3,888	3,888	3,887	3,886	3,883	3,878	3,872	3,872	3,888	0.4%
1928-34 Dry Period Average	3,297	3,297	3,297	3,296	3,295	3,294	3,292	3,290	3,290	3,297	0.2%
Dry Year Average	3,686	3,684	3,684	3,684	3,684	3,681	3,670	3,654	3,654	3,686	0.9%
Critically Dry Year Average	3,151	3,150	3,149	3,148	3,147	3,135	3,123	3,108	3,108	3,151	1.4%
Minimum Annual	2,410	2,411	2,412	2,414	2,418	2,423	2,429	2,433	2,410	2,433	0.9%

Run Identifiers:	SE017	SE018	SE019	SE020	SE021	SE022	SE023	SE024	Minimum Value	Maximum Value	Percent Difference
Storage Carryover Factor	0%	10%	20%	30%	40%	50%	60%	70%			
71-Year Average	3,902	3,902	3,900	3,898	3,896	3,893	3,890	3,884	3,884	3,902	0.5%
1928-34 Dry Period Average	3,289	3,289	3,289	3,288	3,288	3,287	3,286	3,285	3,285	3,289	0.1%
Dry Year Average	3,712	3,707	3,701	3,696	3,692	3,687	3,678	3,667	3,667	3,712	1.2%
Critically Dry Year Average	3,131	3,133	3,129	3,125	3,118	3,107	3,095	3,074	3,074	3,133	1.9%
Minimum Annual	2,410	2,410	2,411	2,413	2,416	2,420	2,424	2,427	2,410	2,427	0.7%

Run Identifiers:	SE025	SE026	SE027	SE028	SE029	SE030	SE031	SE032	Minimum Value	Maximum Value	Percent Difference
Storage Carryover Factor	0%	10%	20%	30%	40%	50%	60%	70%			
71-Year Average	3,849	3,849	3,849	3,849	3,849	3,848	3,847	3,844	3,844	3,849	0.1%
1928-34 Dry Period Average	3,296	3,296	3,295	3,295	3,294	3,293	3,292	3,289	3,289	3,296	0.2%
Dry Year Average	3,611	3,612	3,613	3,614	3,614	3,614	3,612	3,608	3,608	3,614	0.2%
Critically Dry Year Average	3,113	3,111	3,109	3,108	3,107	3,103	3,097	3,087	3,087	3,113	0.8%
Minimum Annual	2,410	2,411	2,414	2,421	2,427	2,430	2,432	2,436	2,410	2,436	1.0%

Run Identifiers:	SE033	SE034	SE035	SE036	SE037	SE038	SE039	SE040	Minimum Value	Maximum Value	Percent Difference
Storage Carryover Factor	0%	10%	20%	30%	40%	50%	60%	70%			
71-Year Average	3,997	3,996	3,994	3,991	3,988	3,984	3,979	3,970	3,970	3,997	0.7%
1928-34 Dry Period Average	3,345	3,344	3,343	3,342	3,341	3,340	3,339	3,335	3,335	3,345	0.3%
Dry Year Average	3,879	3,877	3,878	3,876	3,874	3,868	3,857	3,834	3,834	3,879	1.2%
Critically Dry Year Average	3,268	3,257	3,237	3,213	3,191	3,171	3,149	3,125	3,125	3,268	4.6%
Minimum Annual	2,410	2,415	2,428	2,445	2,465	2,484	2,497	2,502	2,410	2,502	3.8%

Run Identifiers:	SE041	SE042	SE043	SE044	SE045	SE046	SE047	SE048	Minimum Value	Maximum Value	Percent Difference
Storage Carryover Factor	0%	10%	20%	30%	40%	50%	60%	70%			
71-Year Average	3,918	3,917	3,917	3,916	3,915	3,914	3,909	3,904	3,904	3,918	0.3%
1928-34 Dry Period Average	3,357	3,357	3,356	3,354	3,352	3,350	3,345	3,337	3,337	3,357	0.6%
Dry Year Average	3,720	3,723	3,727	3,729	3,731	3,732	3,732	3,728	3,720	3,732	0.3%
Critically Dry Year Average	3,259	3,253	3,246	3,238	3,229	3,216	3,189	3,160	3,160	3,259	3.1%
Minimum Annual	2,505	2,496	2,499	2,537	2,563	2,577	2,579	2,567	2,496	2,579	3.4%

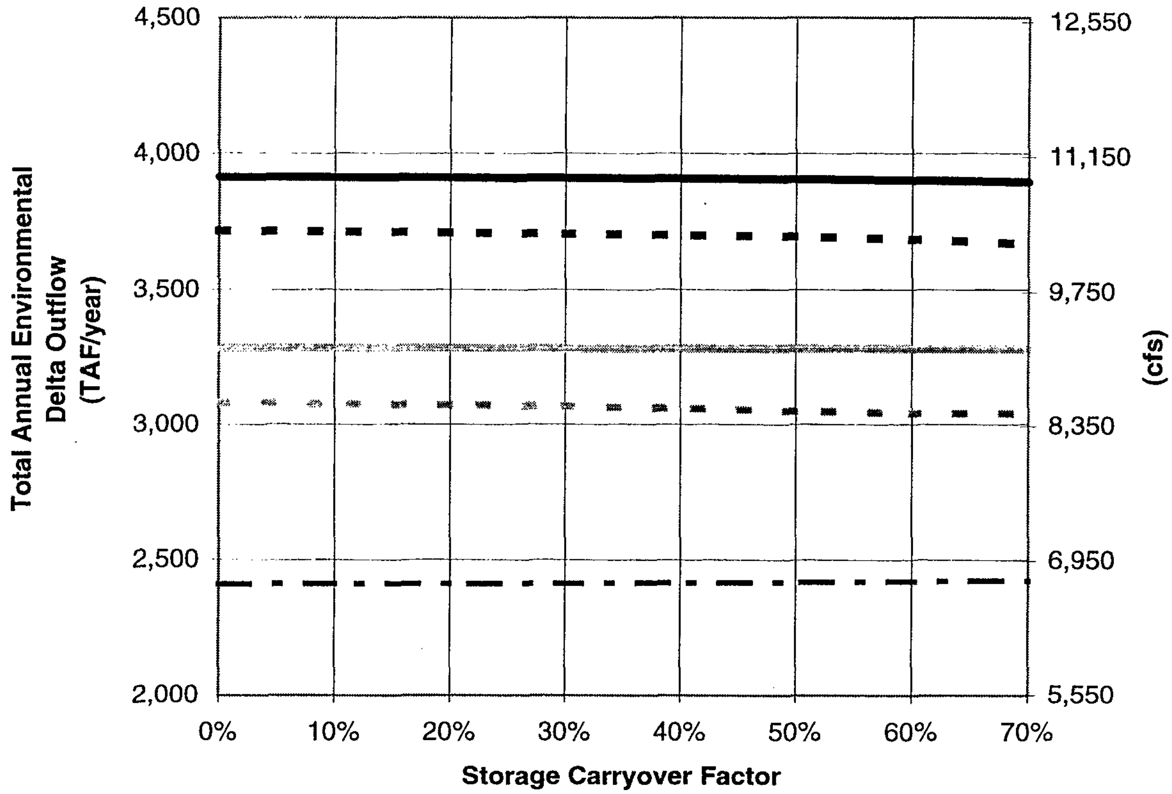
Run Identifiers:	SE049	SE050	SE051	SE052	SE053	SE054	SE055	SE056	Minimum Value	Maximum Value	Percent Difference
Storage Carryover Factor	0%	10%	20%	30%	40%	50%	60%	70%			
71-Year Average	3,959	3,958	3,958	3,957	3,956	3,953	3,948	3,939	3,939	3,959	0.5%
1928-34 Dry Period Average	3,352	3,351	3,350	3,349	3,349	3,348	3,347	3,343	3,343	3,352	0.3%
Dry Year Average	3,811	3,817	3,821	3,823	3,824	3,821	3,814	3,794	3,794	3,824	0.8%
Critically Dry Year Average	3,253	3,243	3,233	3,224	3,214	3,196	3,175	3,146	3,146	3,253	3.4%
Minimum Annual	2,410	2,416	2,431	2,451	2,474	2,499	2,513	2,519	2,410	2,519	4.5%

Run Identifiers:	SE057	SE058	SE059	SE060	SE061	SE062	SE063	SE064	Minimum Value	Maximum Value	Percent Difference
Storage Carryover Factor	0%	10%	20%	30%	40%	50%	60%	70%			
71-Year Average	3,860	3,860	3,860	3,860	3,860	3,859	3,857	3,853	3,853	3,860	0.2%
1928-34 Dry Period Average	3,345	3,346	3,346	3,345	3,342	3,339	3,334	3,324	3,324	3,346	0.6%
Dry Year Average	3,603	3,602	3,601	3,601	3,601	3,601	3,601	3,601	3,601	3,603	0.1%
Critically Dry Year Average	3,189	3,189	3,189	3,189	3,186	3,180	3,167	3,148	3,148	3,189	1.3%
Minimum Annual	2,814	2,808	2,800	2,800	2,755	2,708	2,662	2,622	2,622	2,814	7.3%

[1] See Table SE-3 for description of operational conditions.

Figure SE-3

South of Delta Off-Aqueduct Storage Environmental Water Supply Benefits versus Storage Carryover Factor



Assumptions
Storage Volume = 2.0 MAF
Conveyance Capacity = 3,500 cfs
Existing Banks PP Capacity
Env. Storage Carryover Factor = Varies
Unmet Demand Target Factor = 100%
Jan-Jun Delta Outflow Target = 12,000 cfs

71-Year Average
1928-34 Dry Period Average
Dry Year Average
Critically Dry Year Average
Minimum Annual

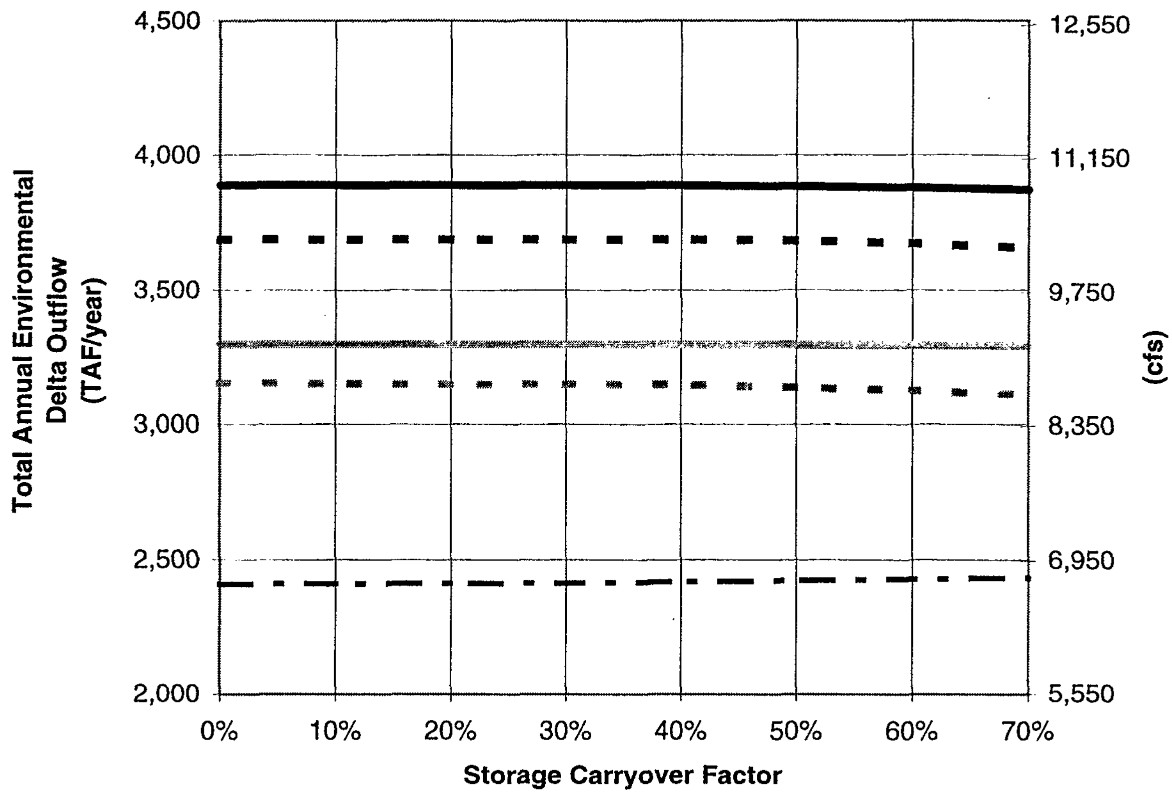
Total Water Supply Benefits (TAF/yr)

Storage Carryover Factor:	0%	70%
71-Year Average:	3,912	3,894
1928-34 Dry Period Average:	3,281	3,278
Average of all Dry Years:	3,716	3,668
Average of all Crit. Dry Years:	3,083	3,039
Minimum Annual:	2,410	2,422

SE_CO1.XLS: XY-Tot Chart 1

Figure SE-4

South of Delta Off-Aqueduct Storage Environmental Water Supply Benefits versus Storage Carryover Factor



Assumptions
Storage Volume = 2.0 MAF
Conveyance Capacity = 3,500 cfs
Existing Banks PP Capacity
Env. Storage Carryover Factor = Varies
Unmet Demand Target Factor = 100%
Jan-Jun Delta Outflow Target = 9,000 cfs

71-Year Average
1928-34 Dry Period Average
Dry Year Average
Critically Dry Year Average
Minimum Annual

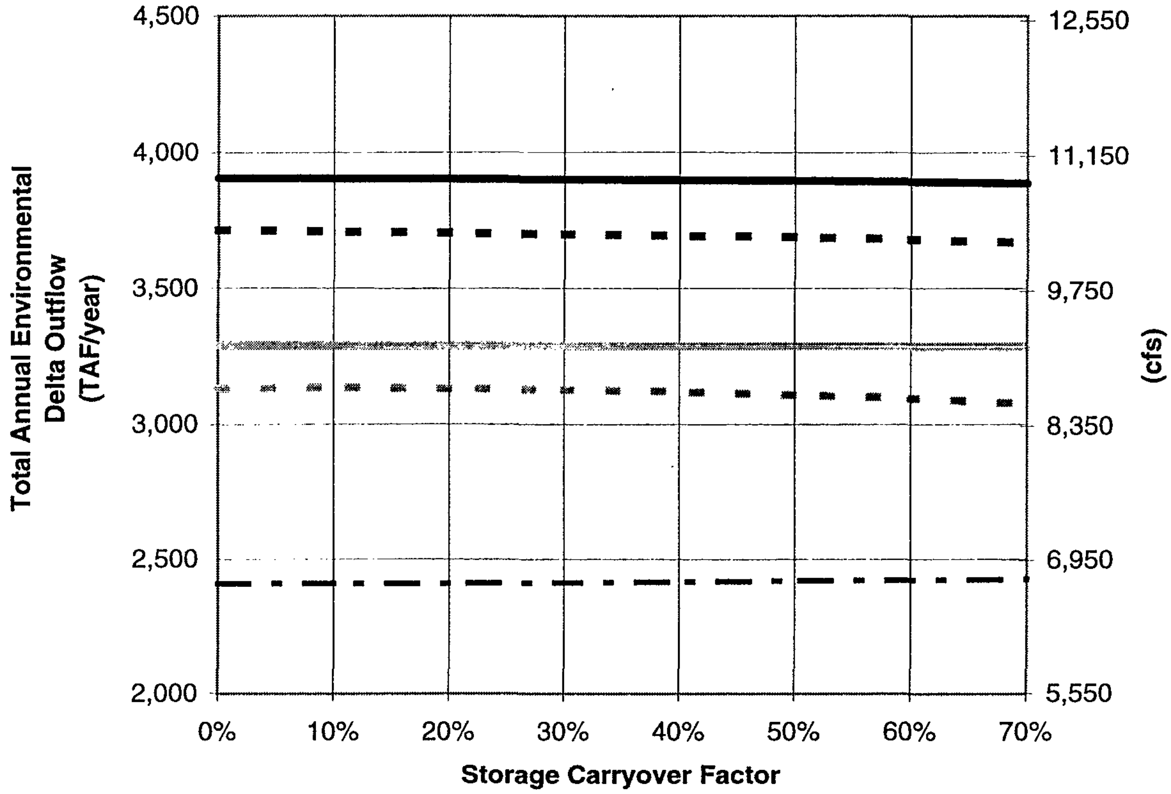
Total Water Supply Benefits (TAF/yr)

Storage Carryover Factor:	0%	70%
71-Year Average:	3,888	3,872
1928-34 Dry Period Average:	3,297	3,290
Average of all Dry Years:	3,686	3,654
Average of all Crit. Dry Years:	3,151	3,108
Minimum Annual:	2,410	2,433

SE_CO2.XLS: XY-Tot Chart 1

Figure SE-5

South of Delta Off-Aqueduct Storage Environmental Water Supply Benefits versus Storage Carryover Factor



Assumptions
Storage Volume = 2.0 MAF
Conveyance Capacity = 3,500 cfs
Existing Banks PP Capacity
Env. Storage Carryover Factor = Varies
Unmet Demand Target Factor = 50%
Jan-Jun Delta Outflow Target = 12,000 cfs

71-Year Average
1928-34 Dry Period Average
Dry Year Average
Critically Dry Year Average
Minimum Annual

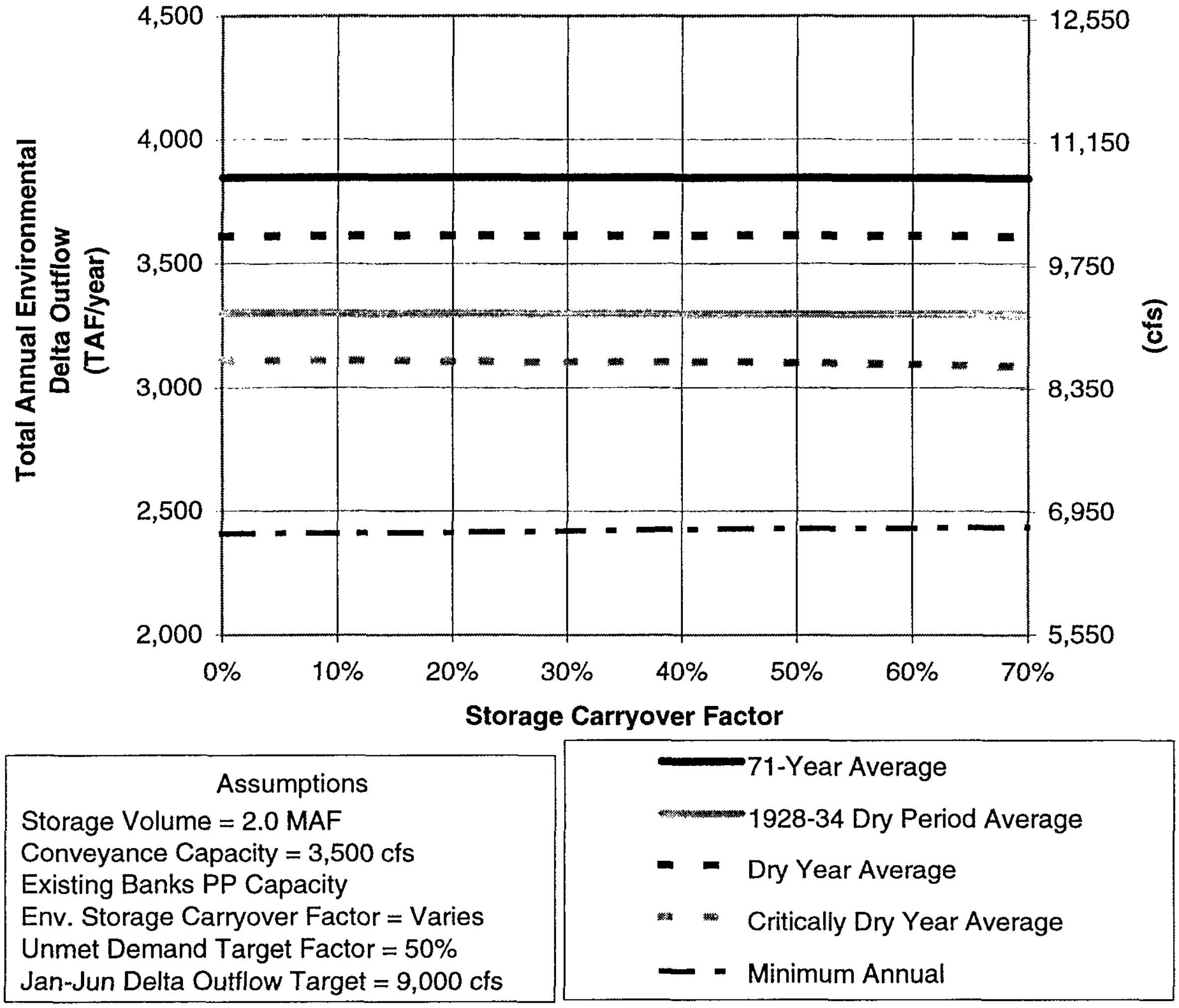
Total Water Supply Benefits (TAF/yr)

Storage Carryover Factor:	0%	70%
71-Year Average:	3,902	3,884
1928-34 Dry Period Average:	3,289	3,285
Average of all Dry Years:	3,712	3,667
Average of all Crit. Dry Years:	3,131	3,074
Minimum Annual:	2,410	2,427

SE_CO3.XLS: XY-Tot Chart 1

Figure SE-6

South of Delta Off-Aqueduct Storage Environmental Water Supply Benefits versus Storage Carryover Factor



Assumptions
Storage Volume = 2.0 MAF
Conveyance Capacity = 3,500 cfs
Existing Banks PP Capacity
Env. Storage Carryover Factor = Varies
Unmet Demand Target Factor = 50%
Jan-Jun Delta Outflow Target = 9,000 cfs

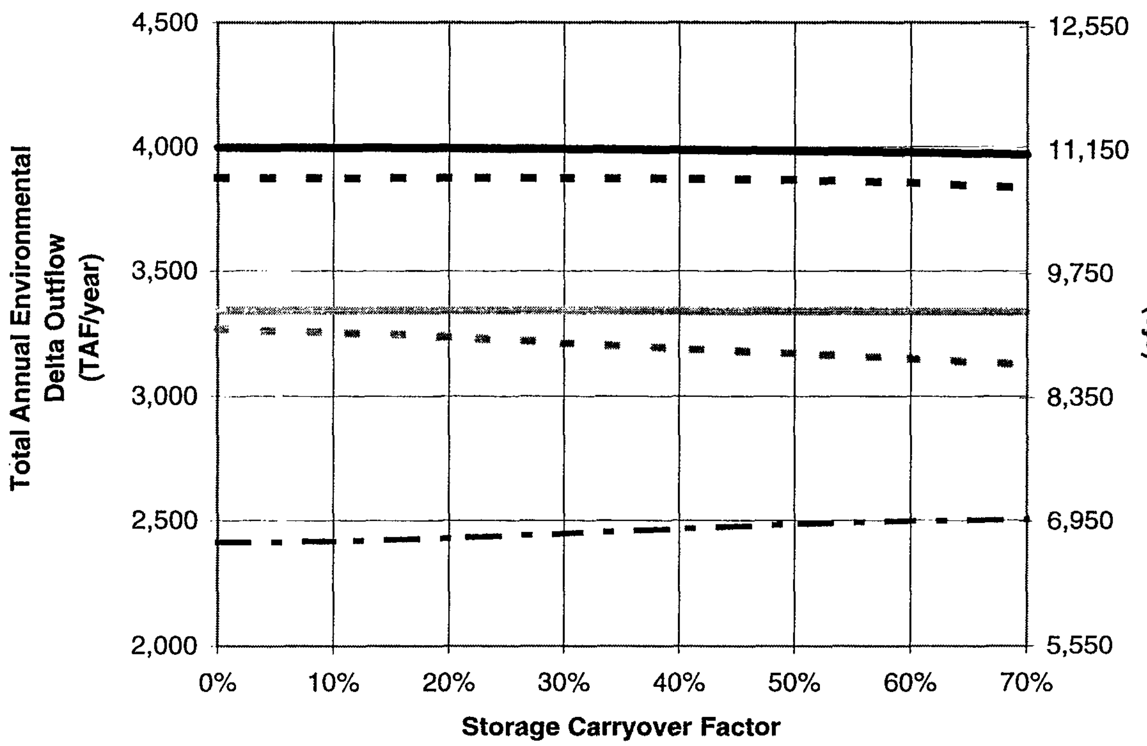
Total Water Supply Benefits (TAF/yr)

Storage Carryover Factor:	0%	70%
71-Year Average:	3,849	3,844
1928-34 Dry Period Average:	3,296	3,289
Average of all Dry Years:	3,611	3,608
Average of all Crit. Dry Years:	3,113	3,087
Minimum Annual:	2,410	2,436

SE_CO4.XLS: XY-Tot Chart 1

Figure SE-7

South of Delta Off-Aqueduct Storage Environmental Water Supply Benefits versus Storage Carryover Factor



Assumptions
Storage Volume = 2.0 MAF
Conveyance Capacity = 3,500 cfs
SDI Banks PP Capacity
Env. Storage Carryover Factor = Varies
Unmet Demand Target Factor = 100%
Jan-Jun Delta Outflow Target = 12,000 cfs

71-Year Average
1928-34 Dry Period Average
Dry Year Average
Critically Dry Year Average
Minimum Annual

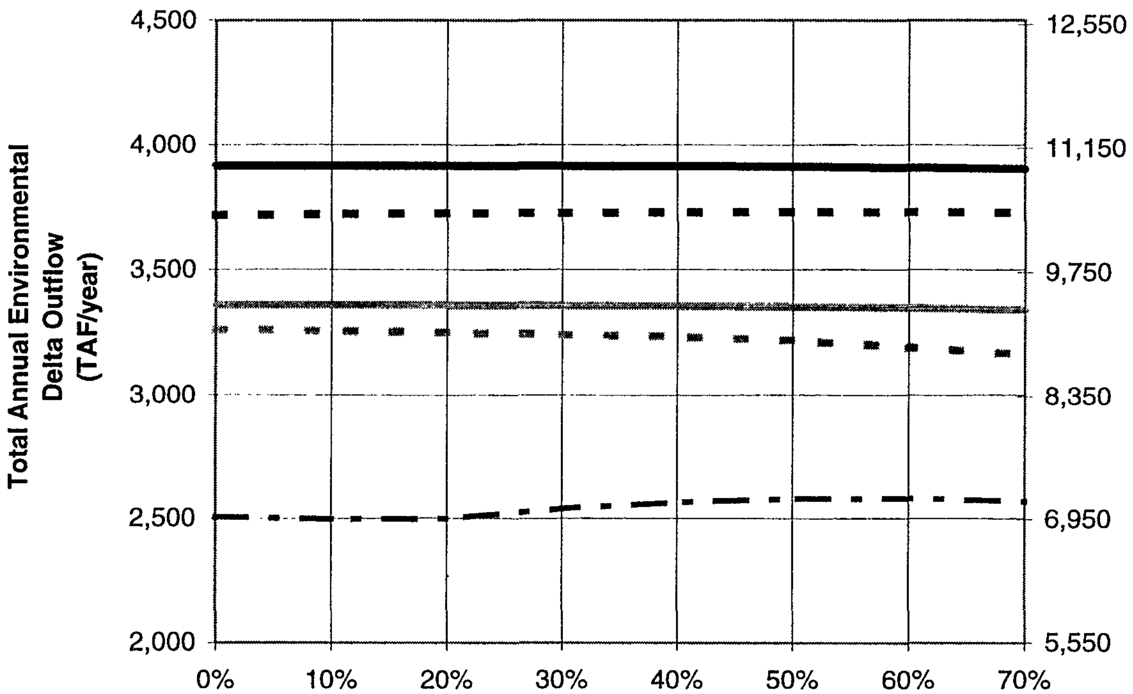
Total Water Supply Benefits (TAF/yr)

Storage Carryover Factor:	0%	70%
71-Year Average:	3,997	3,970
1928-34 Dry Period Average:	3,345	3,335
Average of all Dry Years:	3,879	3,834
Average of all Crit. Dry Years:	3,268	3,125
Minimum Annual:	2,410	2,502

SE_CO5.XLS: XY-Tot Chart 1

Figure SE-8

South of Delta Off-Aqueduct Storage Environmental Water Supply Benefits versus Storage Carryover Factor



Assumptions
Storage Volume = 2.0 MAF
Conveyance Capacity = 3,500 cfs
SDI Banks PP Capacity
Env. Storage Carryover Factor = Varies
Unmet Demand Target Factor = 100%
Jan-Jun Delta Outflow Target = 9,000 cfs

71-Year Average
1928-34 Dry Period Average
Dry Year Average
Critically Dry Year Average
Minimum Annual

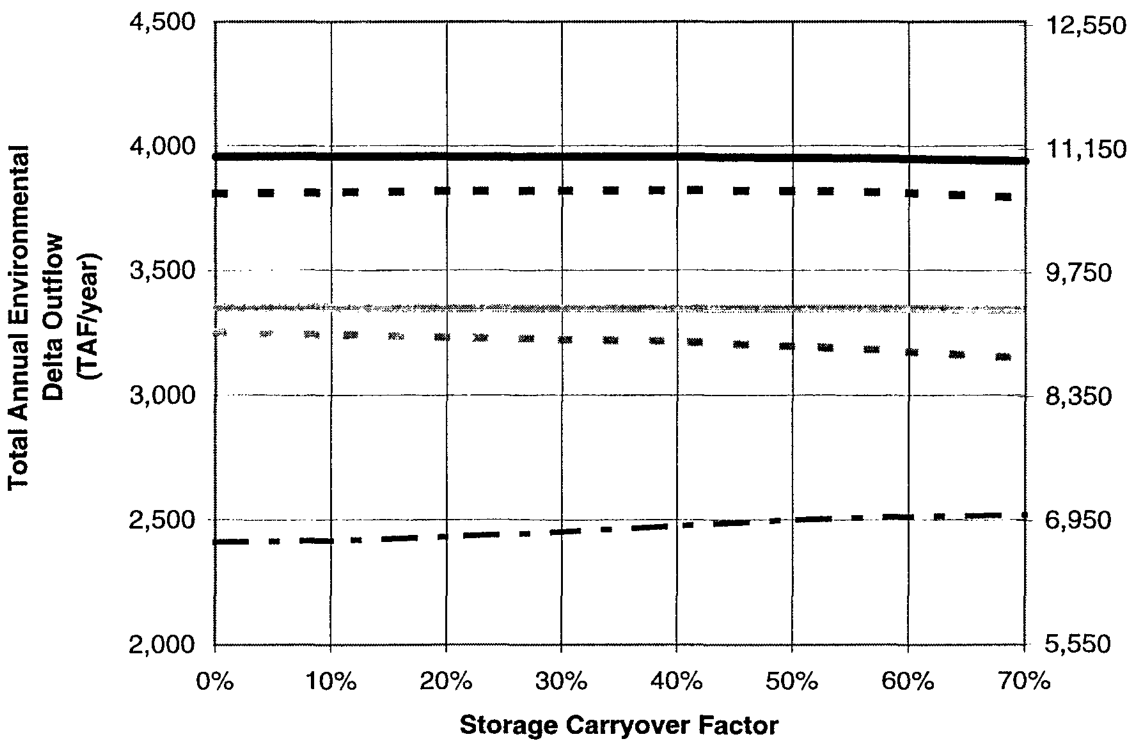
Total Water Supply Benefits (TAF/yr)

Storage Carryover Factor:	0%	70%
71-Year Average:	3,918	3,904
1928-34 Dry Period Average:	3,357	3,337
Average of all Dry Years:	3,720	3,728
Average of all Crit. Dry Years:	3,259	3,160
Minimum Annual:	2,505	2,567

SE_CO6.XLS: XY-Tot Chart 1

Figure SE-9

South of Delta Off-Aqueduct Storage
Environmental Water Supply Benefits versus Storage Carryover Factor



Assumptions
Storage Volume = 2.0 MAF
Conveyance Capacity = 3,500 cfs
SDI Banks PP Capacity
Env. Storage Carryover Factor = Varies
Unmet Demand Target Factor = 50%
Jan-Jun Delta Outflow Target = 12,000 cfs

71-Year Average
1928-34 Dry Period Average
Dry Year Average
Critically Dry Year Average
Minimum Annual

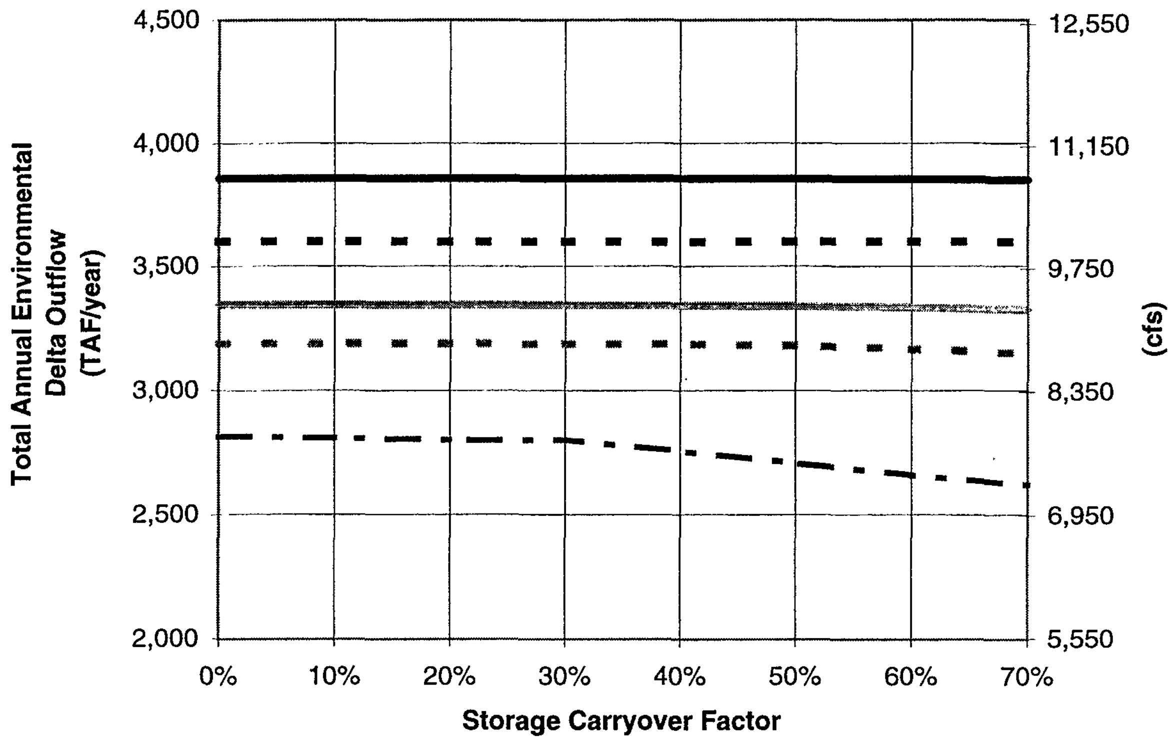
Total Water Supply Benefits (TAF/yr)

Storage Carryover Factor:	0%	70%
71-Year Average:	3,959	3,939
1928-34 Dry Period Average:	3,352	3,343
Average of all Dry Years:	3,811	3,794
Average of all Crit. Dry Years:	3,253	3,146
Minimum Annual:	2,410	2,519

SE_CO7.XLS: XY-Tot Chart 1

Figure SE-10

South of Delta Off-Aqueduct Storage Environmental Water Supply Benefits versus Storage Carryover Factor



Assumptions
Storage Volume = 2.0 MAF
Conveyance Capacity = 3,500 cfs
SDI Banks PP Capacity
Env. Storage Carryover Factor = Varies
Unmet Demand Target Factor = 50%
Jan-Jun Delta Outflow Target = 9,000 cfs

71-Year Average
1928-34 Dry Period Average
Dry Year Average
Critically Dry Year Average
Minimum Annual

Total Water Supply Benefits (TAF/yr)

Storage Carryover Factor:	0%	70%
71-Year Average:	3,860	3,853
1928-34 Dry Period Average:	3,345	3,324
Average of all Dry Years:	3,603	3,601
Average of all Crit. Dry Years:	3,189	3,148
Minimum Annual:	2,814	2,622

SE_CO8.XLS: XY-Tot Chart 1

Water Supply Benefits versus January - June Delta Outflow Target

Background

A minimum Delta outflow target for the months of January through June is used in this evaluation as a surrogate for environmental water demands. Higher demand levels (higher Delta outflow targets) deplete reservoir storage more often, resulting in higher average deliveries over normal hydrologic periods but reduced deliveries during extended dry periods.

Model Runs

Minimum Delta outflow targets ranging from 8,000 to 15,000 cfs were varied in a set of model runs to evaluate effects on water supply benefits 1) with and without expanded Banks Pumping Plant capacity, 2) varied storage carryover factors, and 3) varied unmet demand target factors (described below). These model runs are described in Table SE-5 and summary results are displayed in Table SE-6. For comparability, all results are measured using the Environmental Delta Outflow criteria (average of January through June monthly Delta outflows up to 12,000 cfs) described previously.

Evaluation -- Sensitivity Analysis

Minor effects of varying minimum Delta outflow targets are observed in runs with existing Banks Pumping Plant capacity. Less than a 3-percent increase in 71-Year Average Annual Environmental Delta Outflow and less than a 2-percent decrease in Minimum Annual Environmental Delta Outflow are observed as the operating target is increased from 8,000 to 15,000 cfs. Variable effects are seen in dry and critical year averages, all within a 7-percent range. Plots of the five measures of Environmental Delta Outflow versus January - June Delta outflow target for the existing Banks Pumping Plant capacity condition are shown in Figures SE-11 through SE-14.

Significant effects are observed in runs with expanded Banks Pumping Plant capacity. Increases of 4 to 5 percent occur in 71-year averages. Increases of up to 17 percent in Minimum Annual Environmental Delta Outflow result as the operating target is reduced from 12,000 cfs to 9,000, with storage carryover factor set at 0 percent and unmet demand factor (see next section) set at 50 percent. Plots of the five measures of Environmental Delta Outflow versus January - June Delta outflow target for the expanded Banks Pumping Plant condition are shown in Figures SE-15 through SE-18.

This operational parameter has a significant effect on minimum annual benefits with increased Banks Pumping Plant capacity in place. A target of 9,000 cfs produces the highest minimum annual benefits with minor losses in average annual benefits.

Table SE-5

South of Delta Off-Aqueduct Storage
Model Runs for Evaluation of Delta Outflow Target

Run Results Workbook	Evaluation Workbook	Model Run Identifiers	Delta Outflow Target (cfs)	Common Assumptions
OUT_SO2.XLS	SE_DE1.XLS	SE065	8,000	2.0 maf Maximum Storage Volume
		SE066	9,000	3,500 cfs Inflow/Outflow Capacity
		SE067	10,000	Existing Banks PP Capacity
		SE068	11,000	Storage Carryover Factor = 0%
		SE069	12,000	Unmet Demand Target Factor = 100%
		SE070	13,000	
		SE071	14,000	
		SE072	15,000	
OUT_SO2.XLS	SE_DE2.XLS	SE073	8,000	2.0 maf Maximum Storage Volume
		SE074	9,000	3,500 cfs Inflow/Outflow Capacity
		SE075	10,000	Existing Banks PP Capacity
		SE076	11,000	Storage Carryover Factor = 50%
		SE077	12,000	Unmet Demand Target Factor = 100%
		SE078	13,000	
		SE079	14,000	
		SE080	15,000	
OUT_SO2.XLS	SE_DE3.XLS	SE081	8,000	2.0 maf Maximum Storage Volume
		SE082	9,000	3,500 cfs Inflow/Outflow Capacity
		SE083	10,000	Existing Banks PP Capacity
		SE084	11,000	Storage Carryover Factor = 0%
		SE085	12,000	Unmet Demand Target Factor = 50%
		SE086	13,000	
		SE087	14,000	
		SE088	15,000	
OUT_SO2.XLS	SE_DE4.XLS	SE089	8,000	2.0 maf Maximum Storage Volume
		SE090	9,000	3,500 cfs Inflow/Outflow Capacity
		SE091	10,000	Existing Banks PP Capacity
		SE092	11,000	Storage Carryover Factor = 50%
		SE093	12,000	Unmet Demand Target Factor = 50%
		SE094	13,000	
		SE095	14,000	
		SE096	15,000	
OUT_SO2.XLS	SE_DE5.XLS	SE097	8,000	2.0 maf Maximum Storage Volume
		SE098	9,000	3,500 cfs Inflow/Outflow Capacity
		SE099	10,000	SDI Banks PP Capacity
		SE100	11,000	Storage Carryover Factor = 0%
		SE101	12,000	Unmet Demand Target Factor = 100%
		SE102	13,000	
		SE103	14,000	
		SE104	15,000	
OUT_SO2.XLS	SE_DE6.XLS	SE105	8,000	2.0 maf Maximum Storage Volume
		SE106	9,000	3,500 cfs Inflow/Outflow Capacity
		SE107	10,000	SDI Banks PP Capacity
		SE108	11,000	Storage Carryover Factor = 50%
		SE109	12,000	Unmet Demand Target Factor = 100%
		SE110	13,000	
		SE111	14,000	
		SE112	15,000	
OUT_SO2.XLS	SE_DE7.XLS	SE113	8,000	2.0 maf Maximum Storage Volume
		SE114	9,000	3,500 cfs Inflow/Outflow Capacity
		SE115	10,000	SDI Banks PP Capacity
		SE116	11,000	Storage Carryover Factor = 0%
		SE117	12,000	Unmet Demand Target Factor = 50%
		SE118	13,000	
		SE119	14,000	
		SE120	15,000	
OUT_SO2.XLS	SE_DE8.XLS	SE121	8,000	2.0 maf Maximum Storage Volume
		SE122	9,000	3,500 cfs Inflow/Outflow Capacity
		SE123	10,000	SDI Banks PP Capacity
		SE124	11,000	Storage Carryover Factor = 50%
		SE125	12,000	Unmet Demand Target Factor = 50%
		SE126	13,000	
		SE127	14,000	
		SE128	15,000	

Table SE-6

South of Delta Off-Aqueduct Storage
Environmental Delta Outflow vs. Delta Outflow Target
Under Various Operational Conditions[1]

(Values in thousands of acre-feet)

Run Identifiers:	SE065	SE066	SE067	SE068	SE069	SE070	SE071	SE072	Minimum Value	Maximum Value	Percent Difference
Delta Outflow Target (cfs):	8,000	9,000	10,000	11,000	12,000	13,000	14,000	15,000			
71-Year Average	3,860	3,888	3,902	3,906	3,912	3,917	3,921	3,924	3,860	3,924	1.7%
1928-34 Dry Period Average	3,296	3,297	3,296	3,289	3,281	3,273	3,270	3,270	3,270	3,297	0.8%
Dry Year Average	3,629	3,686	3,706	3,705	3,716	3,727	3,721	3,713	3,629	3,727	2.7%
Critically Dry Year Average	3,135	3,151	3,163	3,147	3,083	3,019	2,985	2,974	2,974	3,163	6.4%
Minimum Annual	2,410	2,410	2,410	2,410	2,410	2,410	2,410	2,410	2,410	2,410	0.0%

Run Identifiers:	SE073	SE074	SE075	SE076	SE077	SE078	SE079	SE080	Minimum Value	Maximum Value	Percent Difference
Delta Outflow Target (cfs):	8,000	9,000	10,000	11,000	12,000	13,000	14,000	15,000			
71-Year Average	3,856	3,883	3,892	3,897	3,904	3,909	3,913	3,916	3,856	3,916	1.6%
1928-34 Dry Period Average	3,294	3,294	3,294	3,287	3,280	3,272	3,270	3,270	3,270	3,294	0.8%
Dry Year Average	3,630	3,681	3,683	3,691	3,694	3,692	3,682	3,677	3,630	3,694	1.8%
Critically Dry Year Average	3,111	3,135	3,133	3,098	3,050	3,020	3,003	2,989	2,989	3,135	4.9%
Minimum Annual	2,423	2,423	2,423	2,419	2,417	2,414	2,413	2,413	2,413	2,423	0.4%

Run Identifiers:	SE081	SE082	SE083	SE084	SE085	SE086	SE087	SE088	Minimum Value	Maximum Value	Percent Difference
Delta Outflow Target (cfs):	8,000	9,000	10,000	11,000	12,000	13,000	14,000	15,000			
71-Year Average	3,821	3,849	3,873	3,888	3,902	3,908	3,912	3,916	3,821	3,916	2.5%
1928-34 Dry Period Average	3,295	3,296	3,296	3,293	3,289	3,286	3,282	3,278	3,278	3,296	0.6%
Dry Year Average	3,558	3,611	3,658	3,683	3,712	3,707	3,716	3,723	3,558	3,723	4.6%
Critically Dry Year Average	3,061	3,113	3,141	3,133	3,131	3,115	3,064	3,014	3,014	3,141	4.2%
Minimum Annual	2,434	2,410	2,410	2,410	2,410	2,410	2,410	2,410	2,410	2,434	1.0%

Run Identifiers:	SE089	SE090	SE091	SE092	SE093	SE094	SE095	SE096	Minimum Value	Maximum Value	Percent Difference
Delta Outflow Target (cfs):	8,000	9,000	10,000	11,000	12,000	13,000	14,000	15,000			
71-Year Average	3,820	3,848	3,869	3,884	3,893	3,900	3,905	3,909	3,820	3,909	2.3%
1928-34 Dry Period Average	3,291	3,293	3,294	3,290	3,287	3,284	3,280	3,276	3,276	3,294	0.5%
Dry Year Average	3,559	3,614	3,650	3,676	3,687	3,694	3,693	3,689	3,559	3,694	3.8%
Critically Dry Year Average	3,054	3,103	3,123	3,126	3,107	3,072	3,035	3,015	3,015	3,126	3.7%
Minimum Annual	2,460	2,430	2,423	2,422	2,420	2,418	2,417	2,415	2,415	2,460	1.8%

Run Identifiers:	SE097	SE098	SE099	SE100	SE101	SE102	SE103	SE104	Minimum Value	Maximum Value	Percent Difference
Delta Outflow Target (cfs):	8,000	9,000	10,000	11,000	12,000	13,000	14,000	15,000			
71-Year Average	3,873	3,918	3,958	3,980	3,997	4,012	4,026	4,038	3,873	4,038	4.3%
1928-34 Dry Period Average	3,350	3,357	3,359	3,352	3,345	3,337	3,335	3,334	3,334	3,359	0.8%
Dry Year Average	3,620	3,720	3,809	3,866	3,879	3,883	3,888	3,899	3,620	3,899	7.7%
Critically Dry Year Average	3,225	3,259	3,288	3,269	3,268	3,239	3,196	3,165	3,165	3,288	3.9%
Minimum Annual	2,699	2,505	2,410	2,410	2,410	2,410	2,410	2,410	2,410	2,699	12.0%

Run Identifiers:	SE105	SE106	SE107	SE108	SE109	SE110	SE111	SE112	Minimum Value	Maximum Value	Percent Difference
Delta Outflow Target (cfs):	8,000	9,000	10,000	11,000	12,000	13,000	14,000	15,000			
71-Year Average	3,868	3,914	3,949	3,967	3,984	3,999	4,015	4,026	3,868	4,026	4.1%
1928-34 Dry Period Average	3,343	3,350	3,354	3,347	3,340	3,332	3,329	3,328	3,328	3,354	0.8%
Dry Year Average	3,622	3,732	3,823	3,858	3,868	3,878	3,882	3,882	3,622	3,882	7.2%
Critically Dry Year Average	3,191	3,216	3,213	3,193	3,171	3,143	3,131	3,128	3,128	3,216	2.8%
Minimum Annual	2,654	2,577	2,531	2,492	2,484	2,476	2,473	2,472	2,472	2,654	7.4%

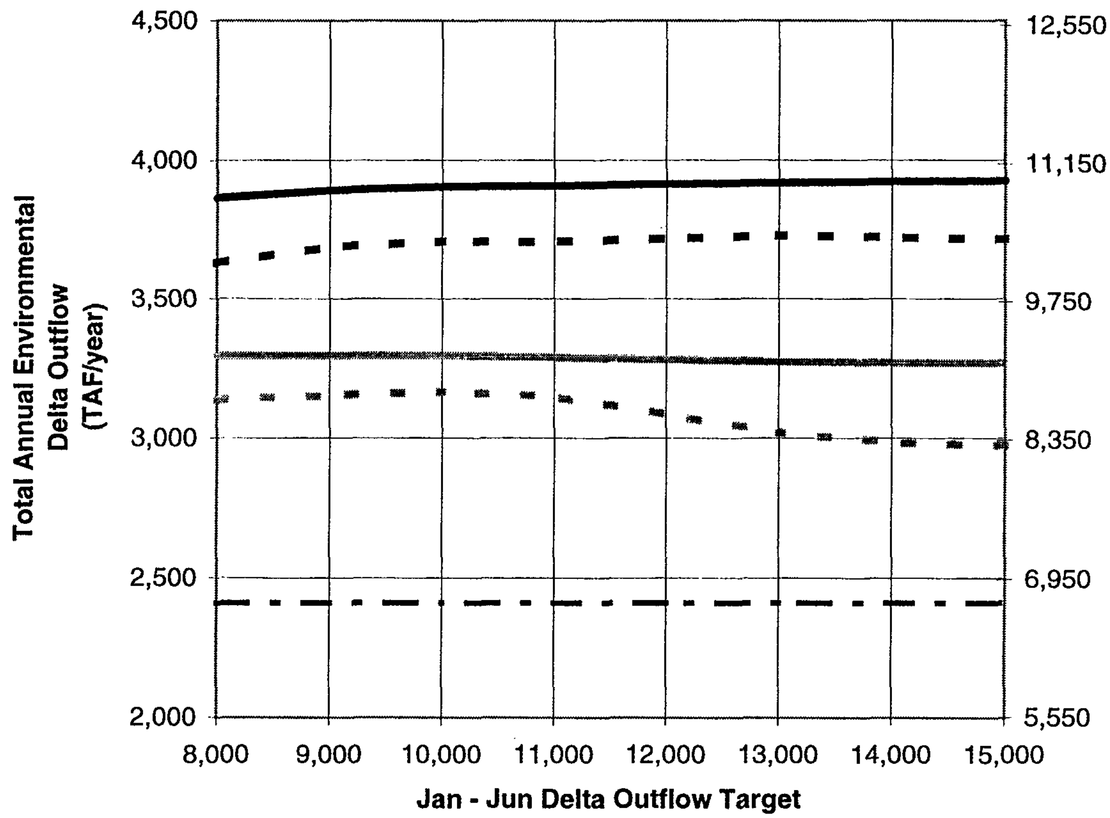
Run Identifiers:	SE113	SE114	SE115	SE116	SE117	SE118	SE119	SE120	Minimum Value	Maximum Value	Percent Difference
Delta Outflow Target (cfs):	8,000	9,000	10,000	11,000	12,000	13,000	14,000	15,000			
71-Year Average	3,826	3,860	3,892	3,922	3,959	3,985	4,001	4,014	3,826	4,014	4.9%
1928-34 Dry Period Average	3,315	3,345	3,351	3,351	3,352	3,349	3,345	3,341	3,315	3,352	1.1%
Dry Year Average	3,543	3,603	3,658	3,731	3,811	3,854	3,868	3,881	3,543	3,881	9.5%
Critically Dry Year Average	3,111	3,189	3,242	3,249	3,253	3,251	3,265	3,227	3,111	3,265	4.9%
Minimum Annual	2,642	2,814	2,699	2,557	2,410	2,410	2,410	2,410	2,410	2,814	16.7%

Run Identifiers:	SE121	SE122	SE123	SE124	SE125	SE126	SE127	SE128	Minimum Value	Maximum Value	Percent Difference
Delta Outflow Target (cfs):	8,000	9,000	10,000	11,000	12,000	13,000	14,000	15,000			
71-Year Average	3,826	3,859	3,888	3,920	3,953	3,973	3,987	4,001	3,826	4,001	4.6%
1928-34 Dry Period Average	3,315	3,339	3,348	3,348	3,348	3,344	3,340	3,335	3,315	3,348	1.0%
Dry Year Average	3,543	3,601	3,669	3,745	3,821	3,848	3,860	3,870	3,543	3,870	9.2%
Critically Dry Year Average	3,111	3,180	3,201	3,209	3,196	3,181	3,159	3,137	3,111	3,209	3.1%
Minimum Annual	2,642	2,708	2,615	2,569	2,499	2,488	2,483	2,478	2,478	2,708	9.3%

[1]See Table SE-5 for description of operational conditions.

Figure SE-11

South of Delta Off-Aqueduct Storage Environmental Water Supply Benefits versus Jan - Jun Delta Outflow Target



Assumptions
Storage Volume = 2.0 MAF
Conveyance Capacity = 3,500 cfs
Existing Banks PP Capacity
Env. Storage Carryover Factor = 0%
Unmet Demand Target Factor = 100%
Jan-Jun Delta Outflow Target = Varies

71-Year Average
1928-34 Dry Period Average
Dry Year Average
Critically Dry Year Average
Minimum Annual

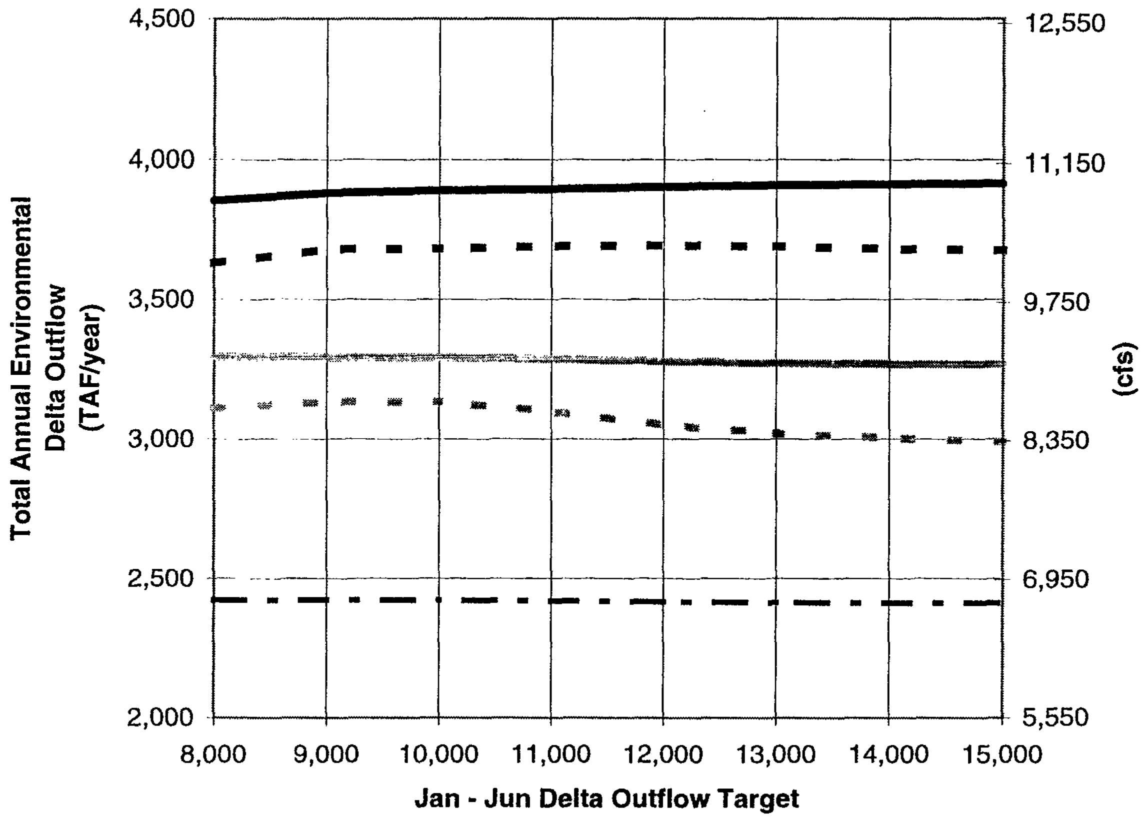
Total Water Supply Benefits (TAF/yr)

Delta Outflow Target (cfs):	8,000	15,000
71-Year Average:	3,860	3,924
1928-34 Dry Period Average:	3,296	3,270
Average of all Dry Years:	3,629	3,713
Average of all Crit. Dry Years:	3,135	2,974
Minimum Annual:	2,410	2,410

SE_DE1.XLS: XY-Tot Chart 1

Figure SE-12

South of Delta Off-Aqueduct Storage Environmental Water Supply Benefits versus Jan - Jun Delta Outflow Target



Assumptions
Storage Volume = 2.0 MAF
Conveyance Capacity = 3,500 cfs
Existing Banks PP Capacity
Env. Storage Carryover Factor = 50%
Unmet Demand Target Factor = 100%
Jan-Jun Delta Outflow Target = Varies

71-Year Average
1928-34 Dry Period Average
Dry Year Average
Critically Dry Year Average
Minimum Annual

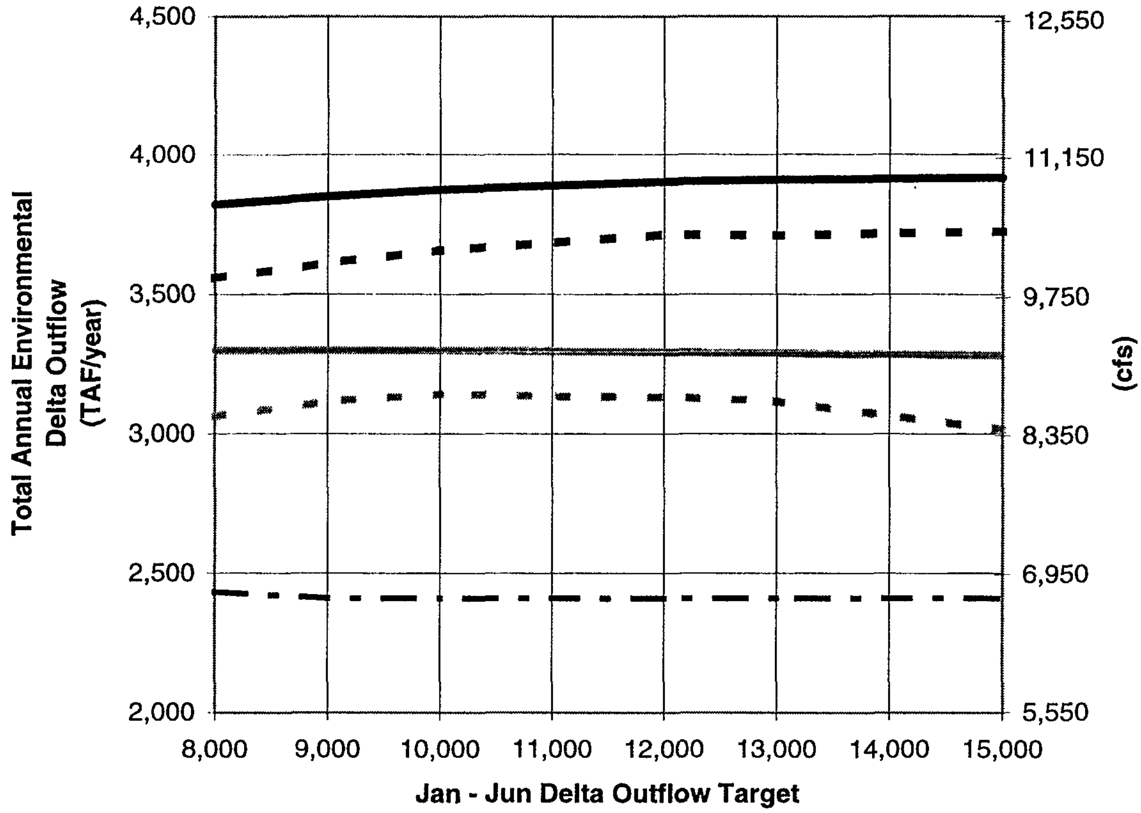
Total Water Supply Benefits (TAF/yr)

Delta Outflow Target (cfs):	8,000	15,000
71-Year Average:	3,856	3,916
1928-34 Dry Period Average:	3,294	3,270
Average of all Dry Years:	3,630	3,677
Average of all Crit. Dry Years:	3,111	2,989
Minimum Annual:	2,423	2,413

SE_DE2.XLS: XY-Tot Chart 1

Figure SE-13

South of Delta Off-Aqueduct Storage Environmental Water Supply Benefits versus Jan - Jun Delta Outflow Target



Assumptions
Storage Volume = 2.0 MAF
Conveyance Capacity = 3,500 cfs
Existing Banks PP Capacity
Env. Storage Carryover Factor = 0%
Unmet Demand Target Factor = 50%
Jan-Jun Delta Outflow Target = Varies

Legend:
- 71-Year Average
- 1928-34 Dry Period Average
- Dry Year Average
- Critically Dry Year Average
- Minimum Annual

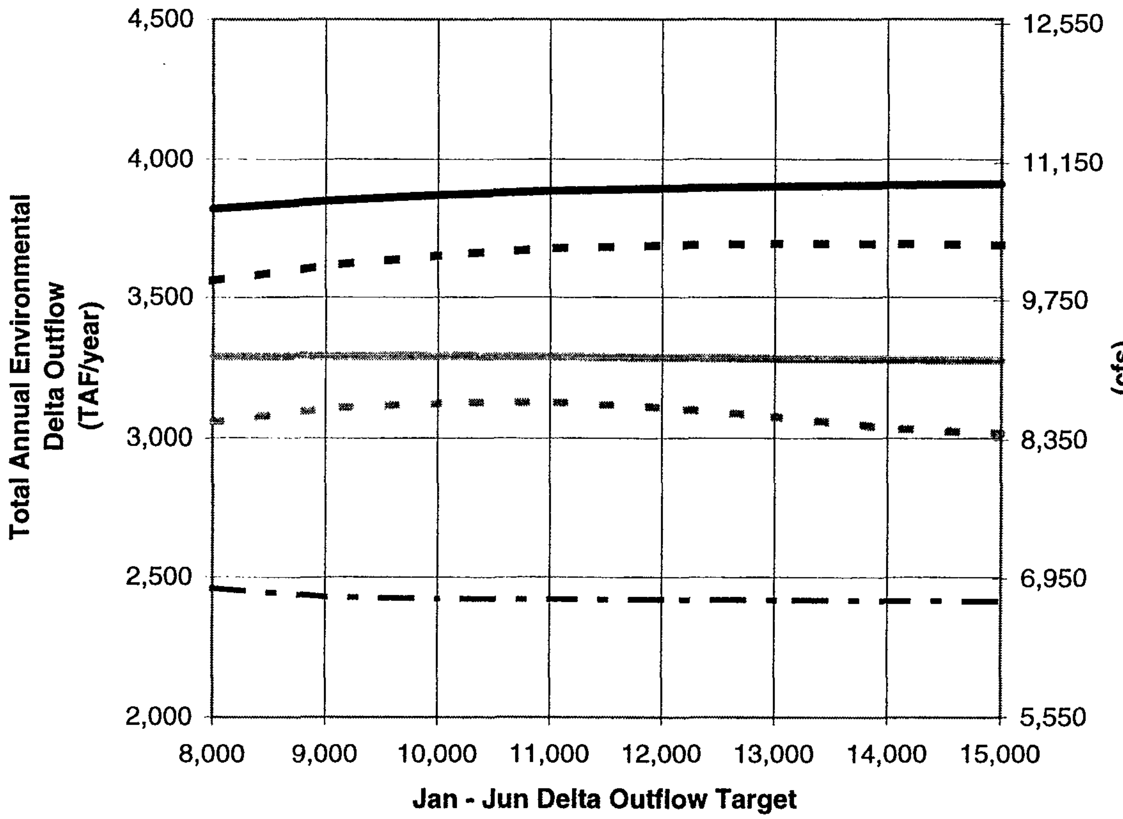
Total Water Supply Benefits (TAF/yr)

Delta Outflow Target (cfs):	8,000	15,000
71-Year Average:	3,821	3,916
1928-34 Dry Period Average:	3,295	3,278
Average of all Dry Years:	3,558	3,723
Average of all Crit. Dry Years:	3,061	3,014
Minimum Annual:	2,434	2,410

SE_DE3.XLS: XY-Tot Chart 1

Figure SE-14

South of Delta Off-Aqueduct Storage Environmental Water Supply Benefits versus Jan - Jun Delta Outflow Target



Assumptions
Storage Volume = 2.0 MAF
Conveyance Capacity = 3,500 cfs
Existing Banks PP Capacity
Env. Storage Carryover Factor = 50%
Unmet Demand Target Factor = 50%
Jan-Jun Delta Outflow Target = Varies

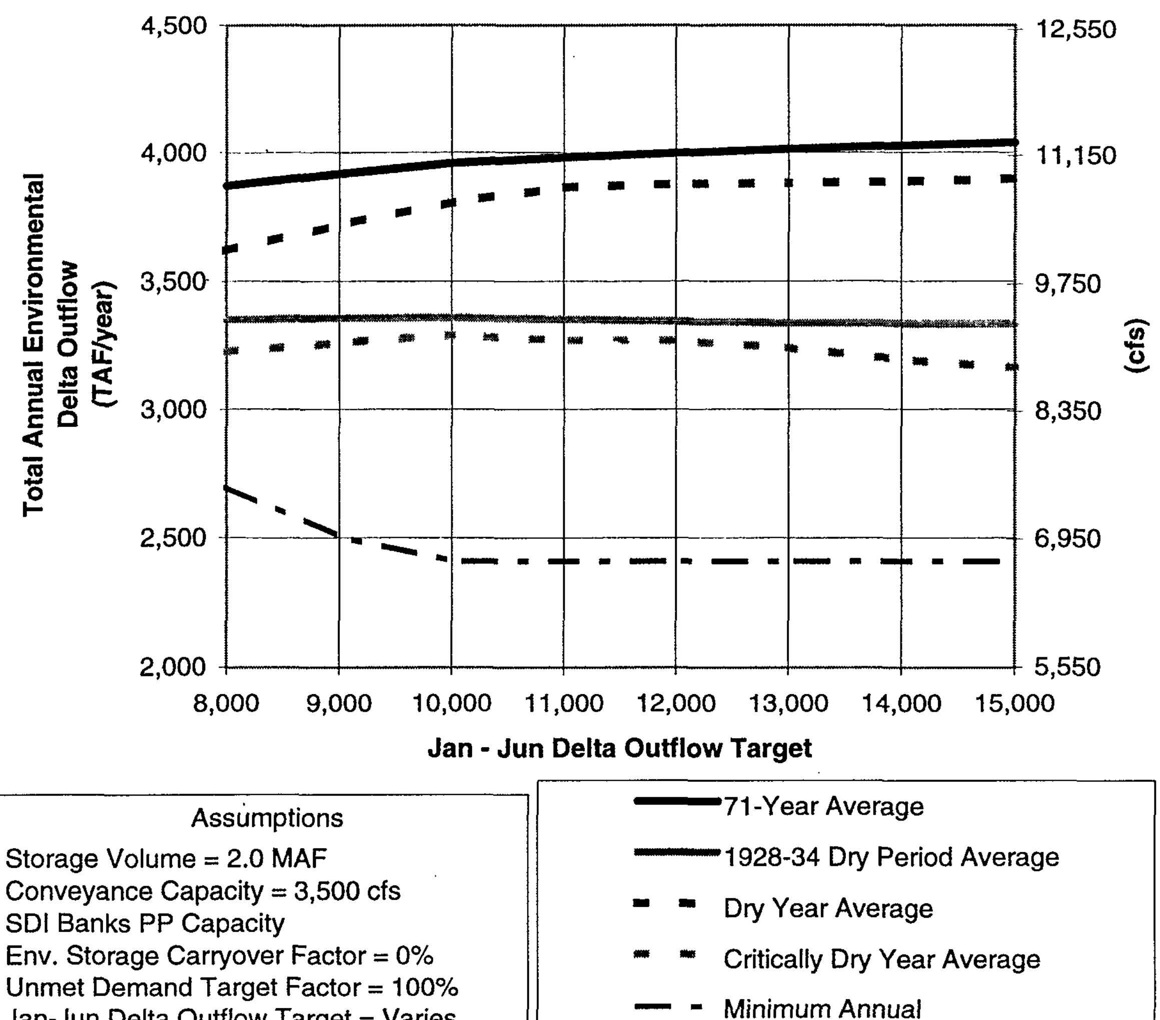
71-Year Average
1928-34 Dry Period Average
Dry Year Average
Critically Dry Year Average
Minimum Annual

Total Water Supply Benefits (TAF/yr)		
Delta Outflow Target (cfs):	8,000	15,000
71-Year Average:	3,820	3,909
1928-34 Dry Period Average:	3,291	3,276
Average of all Dry Years:	3,559	3,689
Average of all Crit. Dry Years:	3,054	3,015
Minimum Annual:	2,460	2,415

SE_DE4.XLS: XY-Tot Chart 1

Figure SE-15

South of Delta Off-Aqueduct Storage Environmental Water Supply Benefits versus Jan - Jun Delta Outflow Target



Assumptions
Storage Volume = 2.0 MAF
Conveyance Capacity = 3,500 cfs
SDI Banks PP Capacity
Env. Storage Carryover Factor = 0%
Unmet Demand Target Factor = 100%
Jan-Jun Delta Outflow Target = Varies

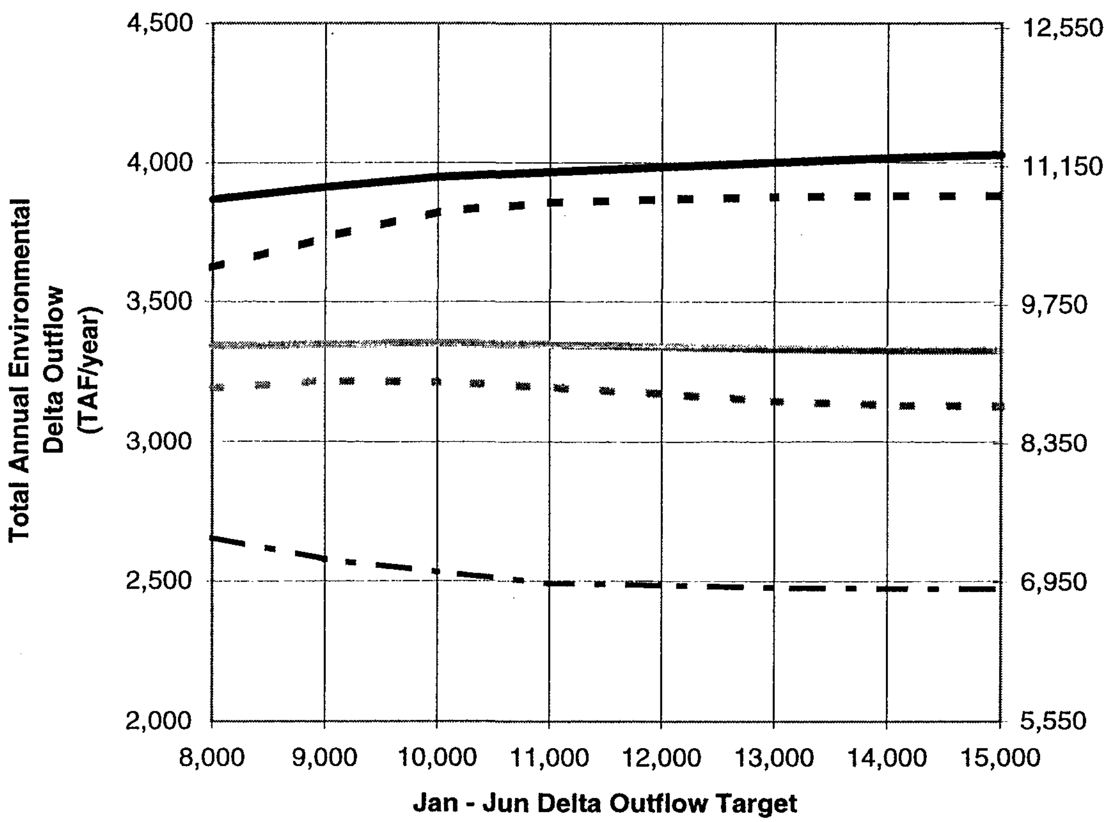
Total Water Supply Benefits (TAF/yr)

Delta Outflow Target (cfs):	8,000	15,000
71-Year Average:	3,873	4,038
1928-34 Dry Period Average:	3,350	3,334
Average of all Dry Years:	3,620	3,899
Average of all Crit. Dry Years:	3,225	3,165
Minimum Annual:	2,699	2,410

SE_DE5.XLS: XY-Tot Chart 1

Figure SE-16

South of Delta Off-Aqueduct Storage Environmental Water Supply Benefits versus Jan - Jun Delta Outflow Target



Assumptions
Storage Volume = 2.0 MAF
Conveyance Capacity = 3,500 cfs
SDI Banks PP Capacity
Env. Storage Carryover Factor = 50%
Unmet Demand Target Factor = 100%
Jan-Jun Delta Outflow Target = Varies

71-Year Average
1928-34 Dry Period Average
Dry Year Average
Critically Dry Year Average
Minimum Annual

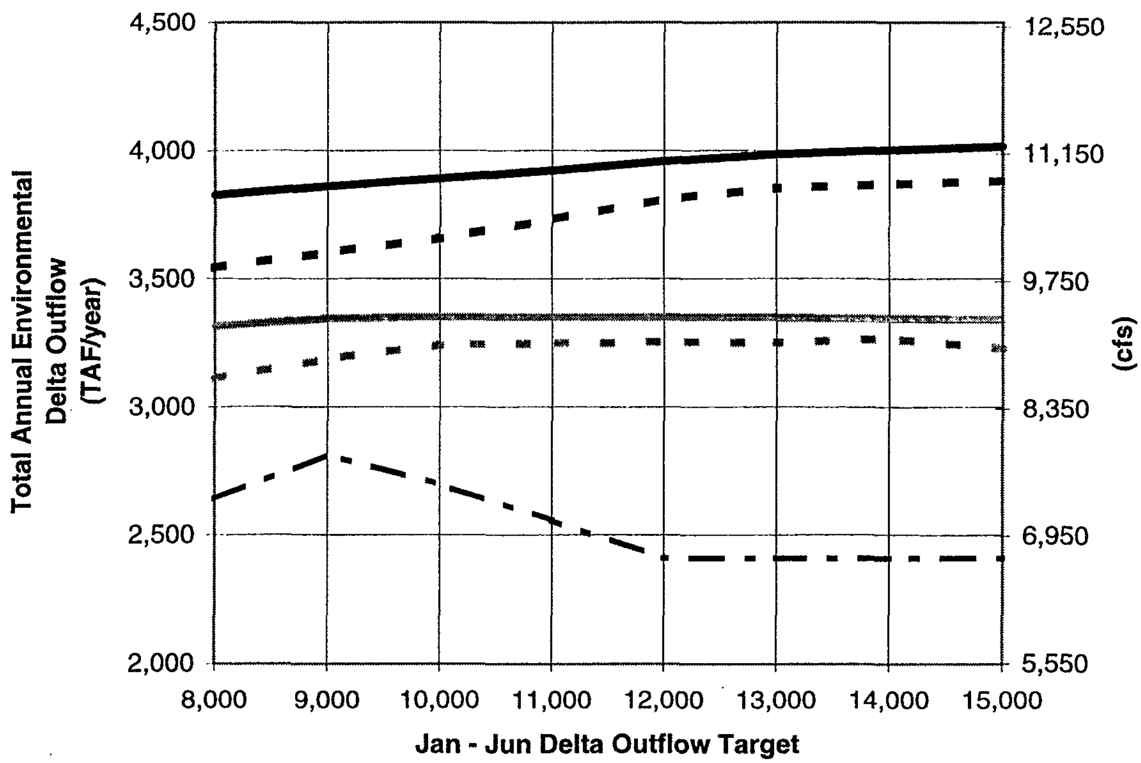
Total Water Supply Benefits (TAF/yr)

Delta Outflow Target (cfs):	8,000	15,000
71-Year Average:	3,868	4,026
1928-34 Dry Period Average:	3,343	3,328
Average of all Dry Years:	3,622	3,882
Average of all Crit. Dry Years:	3,191	3,128
Minimum Annual:	2,654	2,472

SE_DE6.XLS: XY-Tot Chart 1

Figure SE-17

South of Delta Off-Aqueduct Storage Environmental Water Supply Benefits versus Jan - Jun Delta Outflow Target



Assumptions
Storage Volume = 2.0 MAF
Conveyance Capacity = 3,500 cfs
SDI Banks PP Capacity
Env. Storage Carryover Factor = 0%
Unmet Demand Target Factor = 50%
Jan-Jun Delta Outflow Target = Varies

71-Year Average
1928-34 Dry Period Average
Dry Year Average
Critically Dry Year Average
Minimum Annual

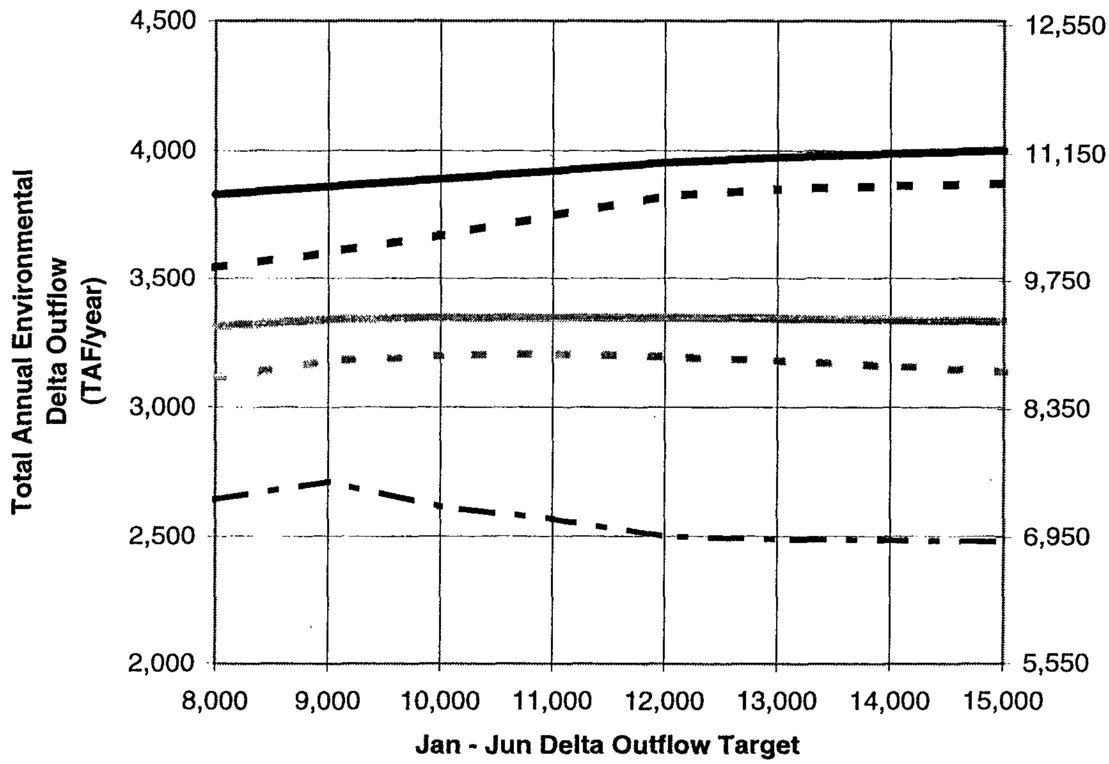
Total Water Supply Benefits (TAF/yr)

Delta Outflow Target (cfs):	8,000	15,000
71-Year Average:	3,826	4,014
1928-34 Dry Period Average:	3,315	3,341
Average of all Dry Years:	3,543	3,881
Average of all Crit. Dry Years:	3,111	3,227
Minimum Annual:	2,642	2,410

SE_DE7.XLS: XY-Tot Chart 1

Figure SE-18

South of Delta Off-Aqueduct Storage Environmental Water Supply Benefits versus Jan - Jun Delta Outflow Target



Assumptions
Storage Volume = 2.0 MAF
Conveyance Capacity = 3,500 cfs
SDI Banks PP Capacity
Env. Storage Carryover Factor = 50%
Unmet Demand Target Factor = 50%
Jan-Jun Delta Outflow Target = Varies

- 71-Year Average
- 1928-34 Dry Period Average
- Dry Year Average
- Critically Dry Year Average
- Minimum Annual

Total Water Supply Benefits (TAF/yr)

Delta Outflow Target (cfs):	8,000	15,000
71-Year Average:	3,826	4,001
1928-34 Dry Period Average:	3,315	3,335
Average of all Dry Years:	3,543	3,870
Average of all Crit. Dry Years:	3,111	3,137
Minimum Annual:	2,642	2,478

SE_DE8.XLS: XY-Tot Chart 1

Environmental Water Supply Benefits versus Unmet Demand Target Factor

Background

Because the storage carryover factor as implemented in the CALFED spreadsheet operations model was only minimally effective in reserving water supplies for the most critically dry years, an additional operational parameter, the unmet demand target factor, was developed and added to the model. The unmet demand target factor limits the amount of release from water supply in any month to a set percentage of the unmet demand. With this factor set at 100 percent, releases are made from storage to meet any shortage in Delta outflow in comparison to the Delta outflow target. With the factor set at 50 percent, releases are made from storage to meet only half of the shortage in Delta outflow. Because unmet demand during extended dry periods overwhelms potential storage facility yield, implementing this parameter at levels below 100 percent limits releases from storage, providing additional supplies in later stages of extended dry periods.

Model Runs

Unmet demand target factors ranging from 30 percent to 100 percent were varied in a set of model runs to evaluate effects on water supply benefits 1) with and without expanded Banks Pumping Plant capacity, 2) varied storage carryover factors, and 3) varied Delta outflow targets. These model runs are described in Table SE-7 and summary results are displayed in Table SE-8. For comparability, all results are measured using the Environmental Delta Outflow criteria (average of January through June monthly Delta outflows up to 12,000 cfs) described previously.

Evaluation -- Sensitivity Analysis

Minor effects were exhibited in model runs with existing Banks Pumping Plant capacity. Less than 2-percent increases in 71-Year Annual Average Environmental Delta Outflow and less than 2-percent decreases in Minimum Annual Environmental Delta Outflow occur as the unmet demand target factor is increased from 30 percent to 100 percent. Maximum increases in Minimum Annual Environmental Delta Outflow occur with the unmet demand factor set at 30 percent. Variable effects occur in dry and critical year averages, all within a 4-percent range. Plots of the five measures of Environmental Delta Outflow versus unmet demand target factor for the existing Banks Pumping Plant capacity condition are shown in Figures SE-19 through SE-22.

More significant effects occur in model runs with expanded Banks Pumping Plant capacity and storage carryover factor set at 0 percent. Along with minor increases of 2 to 3 percent in 71-year Average Annual Environmental Delta Outflow, substantial increases of up to 12 percent in Minimum Annual Environmental Delta Outflow occur with the Delta outflow target set at 12,000 cfs and the storage carryover factor set at 0 percent. With the Delta outflow target set at 9,000 cfs, the storage carryover factor set at 0 percent, and the unmet demand factor set at 50 percent, maximum increases of up to 12 percent in Minimum Annual Environmental Delta Outflow occur. This combination of operation parameters results in the highest Minimum Annual Environmental Delta Outflow of any combination of operational parameters evaluated. Plots of the five measures of Environmental Delta Outflow versus unmet demand target factor for the expanded Banks Pumping Plant capacity condition are shown in Figures SE-23 through SE-26.

The environmental water supply demands considered in this evaluation significantly outweigh potential south of Delta reservoir yields. As a result, the storage carryover factor operational criteria is ineffective in reserving water supplies through extended dry periods. Application of an unmet demand factor of less than 100 percent has the effect of emphasizing deliveries in drier years. This operational control is more effective in maximizing Environmental Delta Outflow in the last years of critical dry periods than the storage carryover factor.

The combination of Delta outflow target set at 9,000 cfs, the storage carryover factor set at 0 percent, and the unmet demand factor set at 50 percent results in the highest Minimum Annual Environmental Delta Outflow of any combination of operational parameters evaluated. However, water supply benefits over normal hydrologic periods are diminished in inverse proportion as critical period supplies are emphasized.

Table SE-7

South of Delta Off-Aqueduct Storage
Model Runs for Evaluation of Unmet Demand Target Factor

Run Results Workbook	Evaluation Workbook	Model Run Identifiers	Unmet Demand Target Factor	Common Assumptions
OUT_SO3.XLS	SE_UD1.XLS	SE129	30%	2.0 maf Maximum Storage Volume
		SE130	40%	3,500 cfs Inflow/Outflow Capacity
		SE131	50%	Existing Banks PP Capacity
		SE132	60%	Jan-Jun Outflow Target = 12,000 cfs
		SE133	70%	Storage Carryover Factor = 0%
		SE134	80%	
		SE135	90%	
		SE136	100%	
OUT_SO3.XLS	SE_UD2.XLS	SE137	30%	2.0 maf Maximum Storage Volume
		SE138	40%	3,500 cfs Inflow/Outflow Capacity
		SE139	50%	Existing Banks PP Capacity
		SE140	60%	Jan-Jun Outflow Target = 12,000 cfs
		SE141	70%	Storage Carryover Factor = 50%
		SE142	80%	
		SE143	90%	
		SE144	100%	
OUT_SO3.XLS	SE_UD3.XLS	SE145	30%	2.0 maf Maximum Storage Volume
		SE146	40%	3,500 cfs Inflow/Outflow Capacity
		SE147	50%	Existing Banks PP Capacity
		SE148	60%	Jan-Jun Outflow Target = 9,000 cfs
		SE149	70%	Storage Carryover Factor = 0%
		SE150	80%	
		SE151	90%	
		SE152	100%	
OUT_SO3.XLS	SE_UD4.XLS	SE153	30%	2.0 maf Maximum Storage Volume
		SE154	40%	3,500 cfs Inflow/Outflow Capacity
		SE155	50%	Existing Banks PP Capacity
		SE156	60%	Jan-Jun Outflow Target = 9,000 cfs
		SE157	70%	Storage Carryover Factor = 50%
		SE158	80%	
		SE159	90%	
		SE160	100%	
OUT_SO3.XLS	SE_UD5.XLS	SE161	30%	2.0 maf Maximum Storage Volume
		SE162	40%	3,500 cfs Inflow/Outflow Capacity
		SE163	50%	SDI Banks PP Capacity
		SE164	60%	Jan-Jun Outflow Target = 12,000 cfs
		SE165	70%	Storage Carryover Factor = 0%
		SE166	80%	
		SE167	90%	
		SE168	100%	
OUT_SO3.XLS	SE_UD6.XLS	SE169	30%	2.0 maf Maximum Storage Volume
		SE170	40%	3,500 cfs Inflow/Outflow Capacity
		SE171	50%	SDI Banks PP Capacity
		SE172	60%	Jan-Jun Outflow Target = 12,000 cfs
		SE173	70%	Storage Carryover Factor = 50%
		SE174	80%	
		SE175	90%	
		SE176	100%	
OUT_SO3.XLS	SE_UD7.XLS	SE177	30%	2.0 maf Maximum Storage Volume
		SE178	40%	3,500 cfs Inflow/Outflow Capacity
		SE179	50%	SDI Banks PP Capacity
		SE180	60%	Jan-Jun Outflow Target = 9,000 cfs
		SE181	70%	Storage Carryover Factor = 0%
		SE182	80%	
		SE183	90%	
		SE184	100%	
OUT_SO3.XLS	SE_UD8.XLS	SE185	30%	2.0 maf Maximum Storage Volume
		SE186	40%	3,500 cfs Inflow/Outflow Capacity
		SE187	50%	SDI Banks PP Capacity
		SE188	60%	Jan-Jun Outflow Target = 9,000 cfs
		SE189	70%	Storage Carryover Factor = 50%
		SE190	80%	
		SE191	90%	
		SE192	100%	

Table SE-8

South of Delta Off-Aqueduct Storage
Environmental Delta Outflow vs. Unmet Demand Target Factor
Under Various Operational Conditions[1]

(Values in thousands of acre-feet)

Run Identifiers:	SE129	SE130	SE131	SE132	SE133	SE134	SE135	SE136	Minimum Value	Maximum Value	Percent Difference
Unmet Demand Target:	30%	40%	50%	60%	70%	80%	90%	100%			
71-Year Average	3,878	3,891	3,902	3,907	3,909	3,910	3,911	3,912	3,878	3,912	0.9%
1928-34 Dry Period Average	3,292	3,291	3,289	3,288	3,286	3,285	3,283	3,281	3,281	3,292	0.3%
Dry Year Average	3,666	3,688	3,712	3,707	3,708	3,714	3,716	3,716	3,666	3,716	1.4%
Critically Dry Year Average	3,122	3,121	3,131	3,133	3,122	3,106	3,093	3,083	3,083	3,133	1.6%
Minimum Annual	2,410	2,410	2,410	2,410	2,410	2,410	2,410	2,410	2,410	2,410	0.0%

Run Identifiers:	SE137	SE138	SE139	SE140	SE141	SE142	SE143	SE144	Minimum Value	Maximum Value	Percent Difference
Unmet Demand Target:	30%	40%	50%	60%	70%	80%	90%	100%			
71-Year Average	3,875	3,887	3,893	3,899	3,900	3,902	3,903	3,904	3,875	3,904	0.8%
1928-34 Dry Period Average	3,290	3,289	3,287	3,285	3,284	3,283	3,281	3,280	3,280	3,290	0.3%
Dry Year Average	3,656	3,676	3,687	3,692	3,692	3,694	3,694	3,694	3,656	3,694	1.0%
Critically Dry Year Average	3,111	3,118	3,107	3,094	3,079	3,067	3,058	3,050	3,050	3,118	2.2%
Minimum Annual	2,421	2,420	2,420	2,419	2,418	2,418	2,417	2,417	2,417	2,421	0.2%

Run Identifiers:	SE145	SE146	SE147	SE148	SE149	SE150	SE151	SE152	Minimum Value	Maximum Value	Percent Difference
Unmet Demand Target:	30%	40%	50%	60%	70%	80%	90%	100%			
71-Year Average	3,821	3,835	3,849	3,862	3,870	3,878	3,884	3,888	3,821	3,888	1.8%
1928-34 Dry Period Average	3,295	3,296	3,296	3,296	3,296	3,297	3,297	3,297	3,295	3,297	0.1%
Dry Year Average	3,561	3,587	3,611	3,636	3,652	3,671	3,685	3,686	3,561	3,686	3.5%
Critically Dry Year Average	3,058	3,085	3,113	3,139	3,143	3,145	3,146	3,151	3,058	3,151	3.1%
Minimum Annual	2,431	2,411	2,410	2,410	2,410	2,410	2,410	2,410	2,410	2,431	0.9%

Run Identifiers:	SE153	SE154	SE155	SE156	SE157	SE158	SE159	SE160	Minimum Value	Maximum Value	Percent Difference
Unmet Demand Target:	30%	40%	50%	60%	70%	80%	90%	100%			
71-Year Average	3,821	3,834	3,848	3,858	3,867	3,874	3,879	3,883	3,821	3,883	1.6%
1928-34 Dry Period Average	3,290	3,292	3,293	3,294	3,294	3,294	3,294	3,294	3,290	3,294	0.1%
Dry Year Average	3,563	3,588	3,614	3,634	3,651	3,662	3,673	3,681	3,563	3,681	3.3%
Critically Dry Year Average	3,051	3,079	3,103	3,115	3,123	3,131	3,135	3,135	3,051	3,135	2.7%
Minimum Annual	2,460	2,445	2,430	2,424	2,423	2,423	2,423	2,423	2,423	2,460	1.5%

Run Identifiers:	SE161	SE162	SE163	SE164	SE165	SE166	SE167	SE168	Minimum Value	Maximum Value	Percent Difference
Unmet Demand Target:	30%	40%	50%	60%	70%	80%	90%	100%			
71-Year Average	3,902	3,932	3,959	3,978	3,987	3,991	3,994	3,997	3,902	3,997	2.4%
1928-34 Dry Period Average	3,347	3,350	3,352	3,351	3,350	3,348	3,346	3,345	3,345	3,352	0.2%
Dry Year Average	3,676	3,748	3,811	3,848	3,866	3,876	3,878	3,879	3,676	3,879	5.5%
Critically Dry Year Average	3,236	3,242	3,253	3,256	3,268	3,271	3,270	3,268	3,236	3,271	1.1%
Minimum Annual	2,699	2,490	2,410	2,410	2,410	2,410	2,410	2,410	2,410	2,699	12.0%

Run Identifiers:	SE169	SE170	SE171	SE172	SE173	SE174	SE175	SE176	Minimum Value	Maximum Value	Percent Difference
Unmet Demand Target:	30%	40%	50%	60%	70%	80%	90%	100%			
71-Year Average	3,899	3,929	3,953	3,967	3,973	3,978	3,981	3,984	3.899	3,984	2.2%
1928-34 Dry Period Average	3,347	3,347	3,348	3,347	3,345	3,343	3,342	3,340	3,340	3,348	0.2%
Dry Year Average	3,690	3,761	3,821	3,846	3,856	3,864	3,866	3,868	3,690	3,868	4.8%
Critically Dry Year Average	3,194	3,204	3,196	3,194	3,188	3,182	3,176	3,171	3,171	3,204	1.1%
Minimum Annual	2,591	2,544	2,499	2,491	2,489	2,488	2,486	2,484	2,484	2,591	4.3%

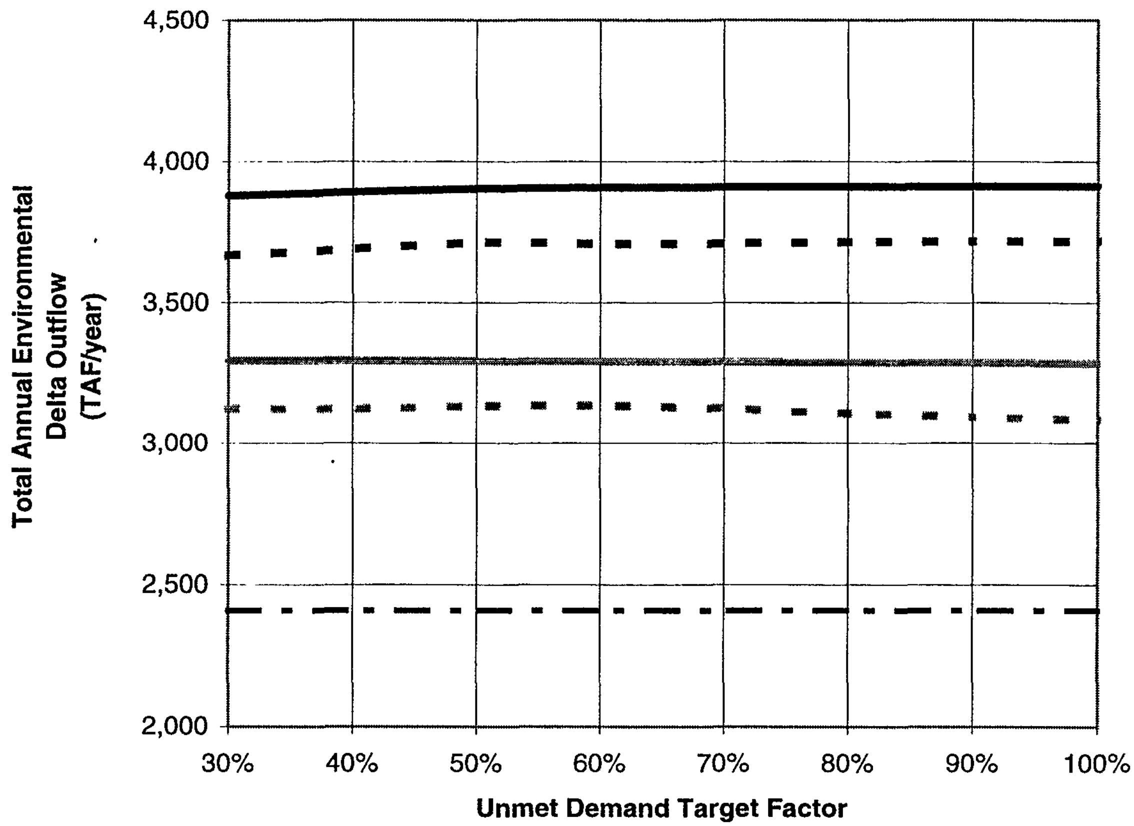
Run Identifiers:	SE177	SE178	SE179	SE180	SE181	SE182	SE183	SE184	Minimum Value	Maximum Value	Percent Difference
Unmet Demand Target:	30%	40%	50%	60%	70%	80%	90%	100%			
71-Year Average	3,828	3,845	3,860	3,875	3,887	3,898	3,908	3,918	3,828	3,918	2.4%
1928-34 Dry Period Average	3,320	3,343	3,345	3,350	3,352	3,354	3,355	3,357	3,320	3,357	1.1%
Dry Year Average	3,547	3,577	3,603	3,626	3,649	3,672	3,697	3,720	3,547	3,720	4.9%
Critically Dry Year Average	3,111	3,156	3,189	3,224	3,241	3,250	3,253	3,259	3,111	3,259	4.8%
Minimum Annual	2,656	2,739	2,814	2,699	2,699	2,690	2,597	2,505	2,505	2,814	12.3%

Run Identifiers:	SE185	SE186	SE187	SE188	SE189	SE190	SE191	SE192	Minimum Value	Maximum Value	Percent Difference
Unmet Demand Target:	30%	40%	50%	60%	70%	80%	90%	100%			
71-Year Average	3,828	3,844	3,859	3,871	3,883	3,893	3,904	3,914	3,828	3,914	2.2%
1928-34 Dry Period Average	3,320	3,335	3,339	3,343	3,346	3,347	3,348	3,350	3,320	3,350	0.9%
Dry Year Average	3,547	3,574	3,601	3,629	3,656	3,683	3,709	3,732	3,547	3,732	5.2%
Critically Dry Year Average	3,111	3,151	3,180	3,195	3,203	3,209	3,213	3,216	3,111	3,216	3.4%
Minimum Annual	2,656	2,739	2,708	2,662	2,622	2,608	2,592	2,577	2,577	2.739	6.3%

[1]See Table SE-7 for description of operational conditions.

Figure SE-19

South of Delta Off-Aqueduct Storage Environmental Water Supply Benefits versus Unmet Demand Target Factor



Assumptions
Storage Volume = 2.0 MAF
Conveyance Capacity = 3,500 cfs
Existing Banks PP Capacity
Env. Storage Carryover Factor = 0%
Unmet Demand Target Factor = Varies
Jan-Jun Delta Outflow Target = 12,000 cfs

71-Year Average
1928-34 Dry Period Average
Dry Year Average
Critically Dry Year Average
Minimum Annual

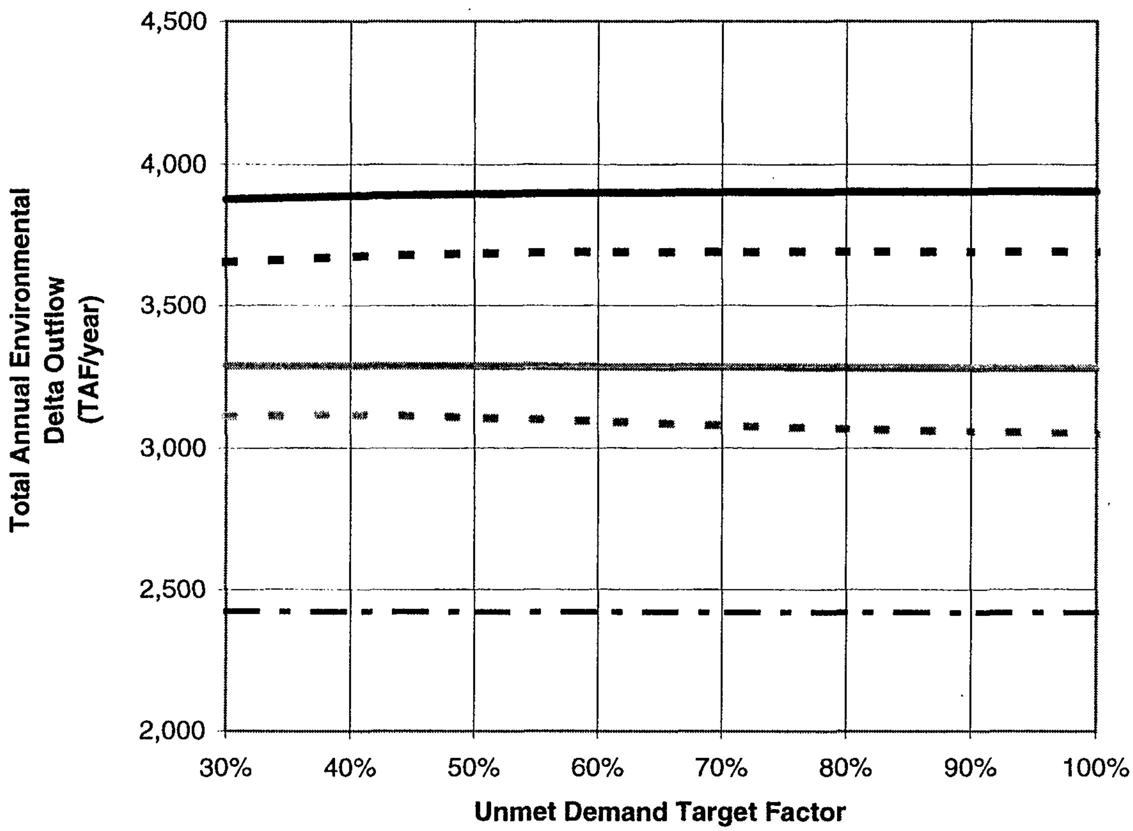
Total Water Supply Benefits (TAF/yr)

Unmet Demand Target:	30%	100%
71-Year Average:	3,878	3,912
1928-34 Dry Period Average:	3,292	3,281
Average of all Dry Years:	3,666	3,716
Average of all Crit. Dry Years:	3,122	3,083
Minimum Annual:	2,410	2,410

SE_UD1.XLS: XY-Tot Chart 1

Figure SE-20

South of Delta Off-Aqueduct Storage
Environmental Water Supply Benefits versus Unmet Demand Target Factor



Assumptions	
Storage Volume = 2.0 MAF	71-Year Average
Conveyance Capacity = 3,500 cfs	1928-34 Dry Period Average
Existing Banks PP Capacity	Dry Year Average
Env. Storage Carryover Factor = 50%	Critically Dry Year Average
Unmet Demand Target Factor = Varies	Minimum Annual
Jan-Jun Delta Outflow Target = 12,000 cfs	

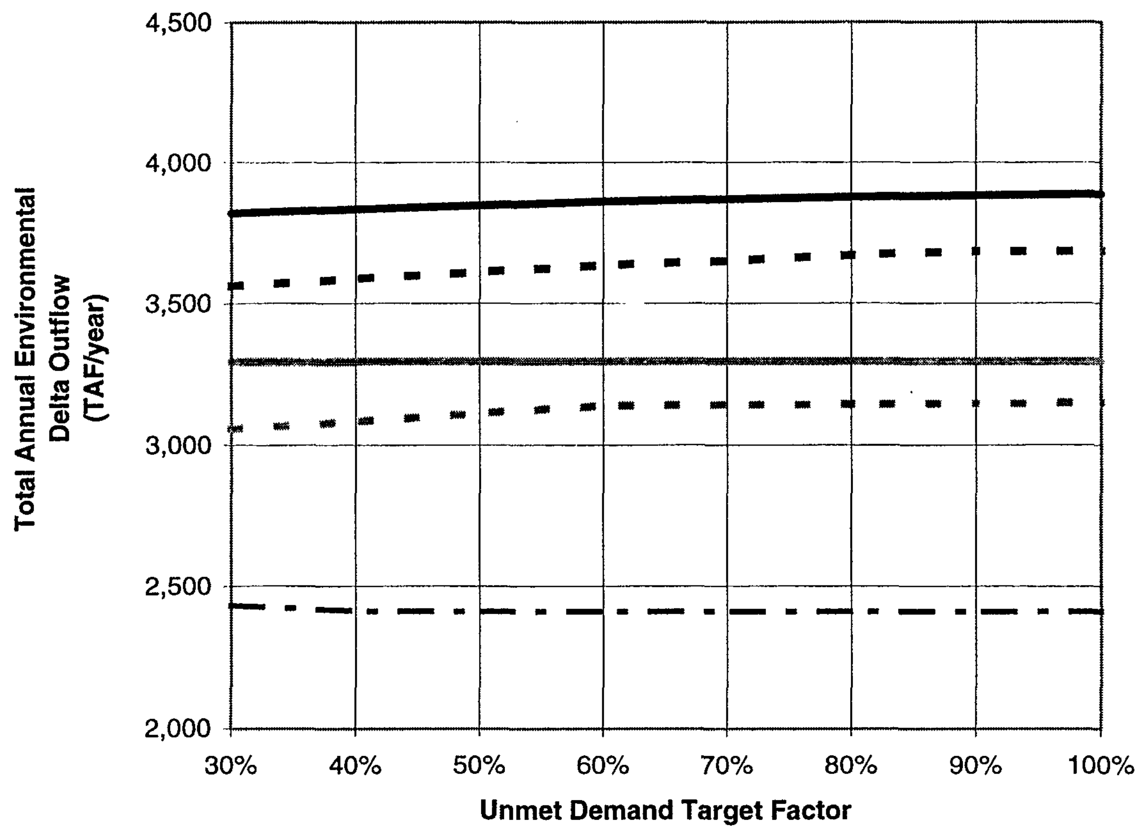
Total Water Supply Benefits (TAF/yr)

Unmet Demand Target:	30%	100%
71-Year Average:	3,875	3,904
1928-34 Dry Period Average:	3,290	3,280
Average of all Dry Years:	3,656	3,694
Average of all Crit. Dry Years:	3,111	3,050
Minimum Annual:	2,421	2,417

SE_UD2.XLS: XY-Tot Chart 1

Figure SE-21

South of Delta Off-Aqueduct Storage Environmental Water Supply Benefits versus Unmet Demand Target Factor



Assumptions	
Storage Volume = 2.0 MAF	71-Year Average
Conveyance Capacity = 3,500 cfs	1928-34 Dry Period Average
Existing Banks PP Capacity	Dry Year Average
Env. Storage Carryover Factor = 0%	Critically Dry Year Average
Unmet Demand Target Factor = Varies	Minimum Annual
Jan-Jun Delta Outflow Target = 9,000 cfs	

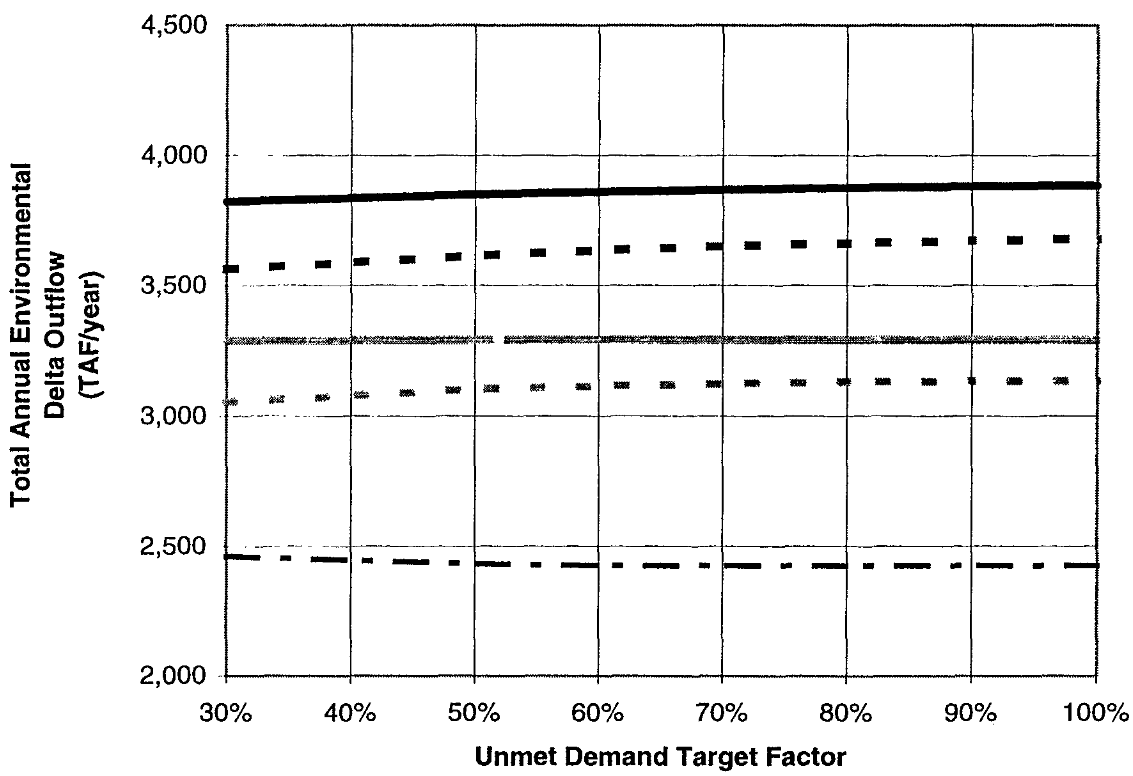
Total Water Supply Benefits (TAF/yr)

Unmet Demand Target:	30%	100%
71-Year Average:	3,821	3,888
1928-34 Dry Period Average:	3,295	3,297
Average of all Dry Years:	3,561	3,686
Average of all Crit. Dry Years:	3,058	3,151
Minimum Annual:	2,431	2,410

SE_UD3.XLS: XY-Tot Chart 1

Figure SE-22

South of Delta Off-Aqueduct Storage Environmental Water Supply Benefits versus Unmet Demand Target Factor



Assumptions	Legend
Storage Volume = 2.0 MAF	71-Year Average
Conveyance Capacity = 3,500 cfs	1928-34 Dry Period Average
Existing Banks PP Capacity	Dry Year Average
Env. Storage Carryover Factor = 50%	Critically Dry Year Average
Unmet Demand Target Factor = Varies	Minimum Annual
Jan-Jun Delta Outflow Target = 9,000 cfs	

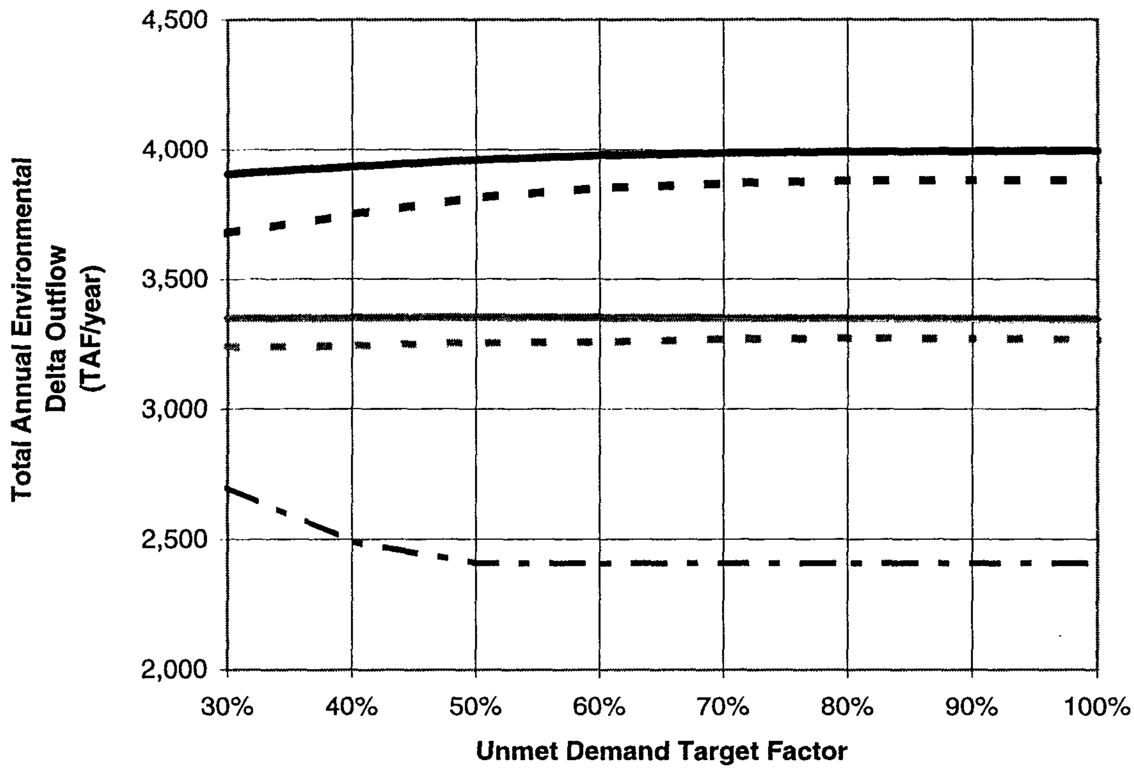
Total Water Supply Benefits (TAF/yr)

Unmet Demand Target:	30%	100%
71-Year Average:	3,821	3,883
1928-34 Dry Period Average:	3,290	3,294
Average of all Dry Years:	3,563	3,681
Average of all Crit. Dry Years:	3,051	3,135
Minimum Annual:	2,460	2,423

SE_UD4.XLS: XY-Tot Chart 1

Figure SE-23

South of Delta Off-Aqueduct Storage Environmental Water Supply Benefits versus Unmet Demand Target Factor



Assumptions
Storage Volume = 2.0 MAF
Conveyance Capacity = 3,500 cfs
SDI Banks PP Capacity
Env. Storage Carryover Factor = 0%
Unmet Demand Target Factor = Varies
Jan-Jun Delta Outflow Target = 12,000 cfs

71-Year Average
1928-34 Dry Period Average
Dry Year Average
Critically Dry Year Average
Minimum Annual

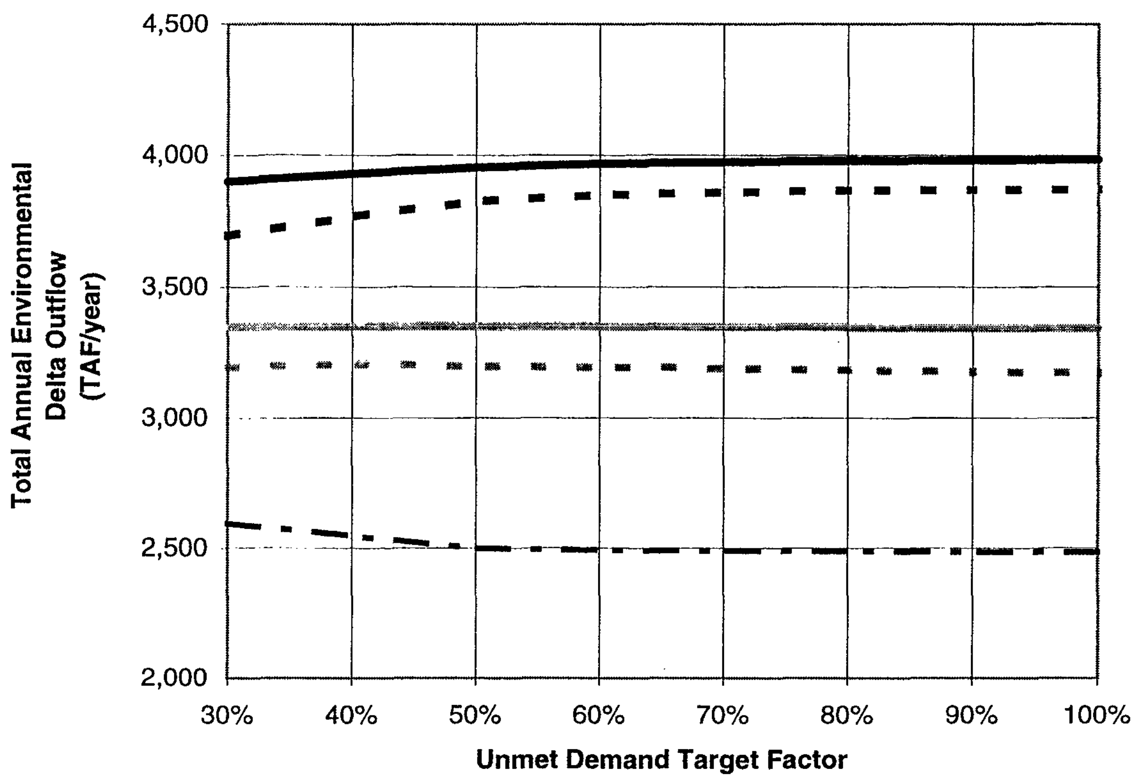
Total Water Supply Benefits (TAF/yr)

Unmet Demand Target:	30%	100%
71-Year Average:	3,902	3,997
1928-34 Dry Period Average:	3,347	3,345
Average of all Dry Years:	3,676	3,879
Average of all Crit. Dry Years:	3,236	3,268
Minimum Annual:	2,699	2,410

SE_UD5.XLS: XY-Tot Chart 1

Figure SE-24

South of Delta Off-Aqueduct Storage Environmental Water Supply Benefits versus Unmet Demand Target Factor



Assumptions	Legend
Storage Volume = 2.0 MAF	71-Year Average
Conveyance Capacity = 3,500 cfs	1928-34 Dry Period Average
SDI Banks PP Capacity	Dry Year Average
Env. Storage Carryover Factor = 50%	Critically Dry Year Average
Unmet Demand Target Factor = Varies	Minimum Annual
Jan-Jun Delta Outflow Target = 12,000 cfs	

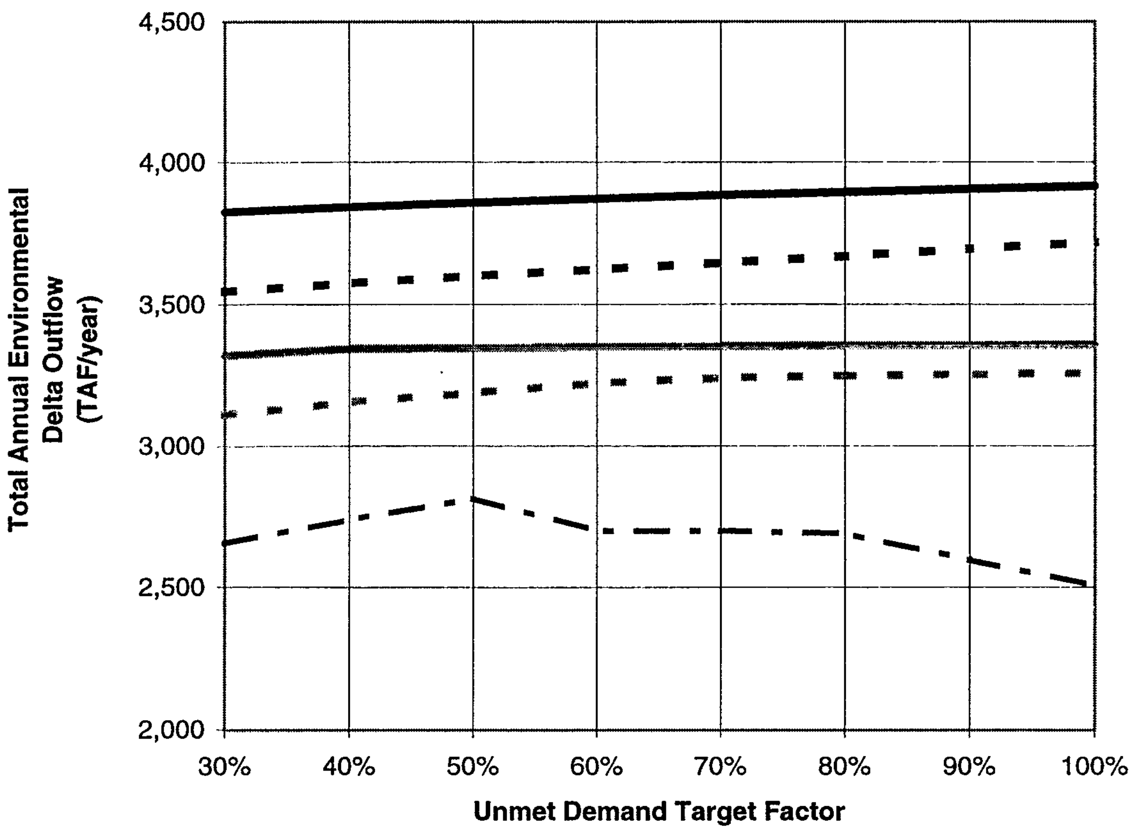
Total Water Supply Benefits (TAF/yr)

Unmet Demand Target:	30%	100%
71-Year Average:	3,899	3,984
1928-34 Dry Period Average:	3,347	3,340
Average of all Dry Years:	3,690	3,868
Average of all Crit. Dry Years:	3,194	3,171
Minimum Annual:	2,591	2,484

SE_UD6.XLS: XY-Tot Chart 1

Figure SE-25

South of Delta Off-Aqueduct Storage
Environmental Water Supply Benefits versus Unmet Demand Target Factor



Assumptions	
Storage Volume = 2.0 MAF	71-Year Average
Conveyance Capacity = 3,500 cfs	1928-34 Dry Period Average
SDI Banks PP Capacity	Dry Year Average
Env. Storage Carryover Factor = 0%	Critically Dry Year Average
Unmet Demand Target Factor = Varies	Minimum Annual
Jan-Jun Delta Outflow Target = 9,000 cfs	

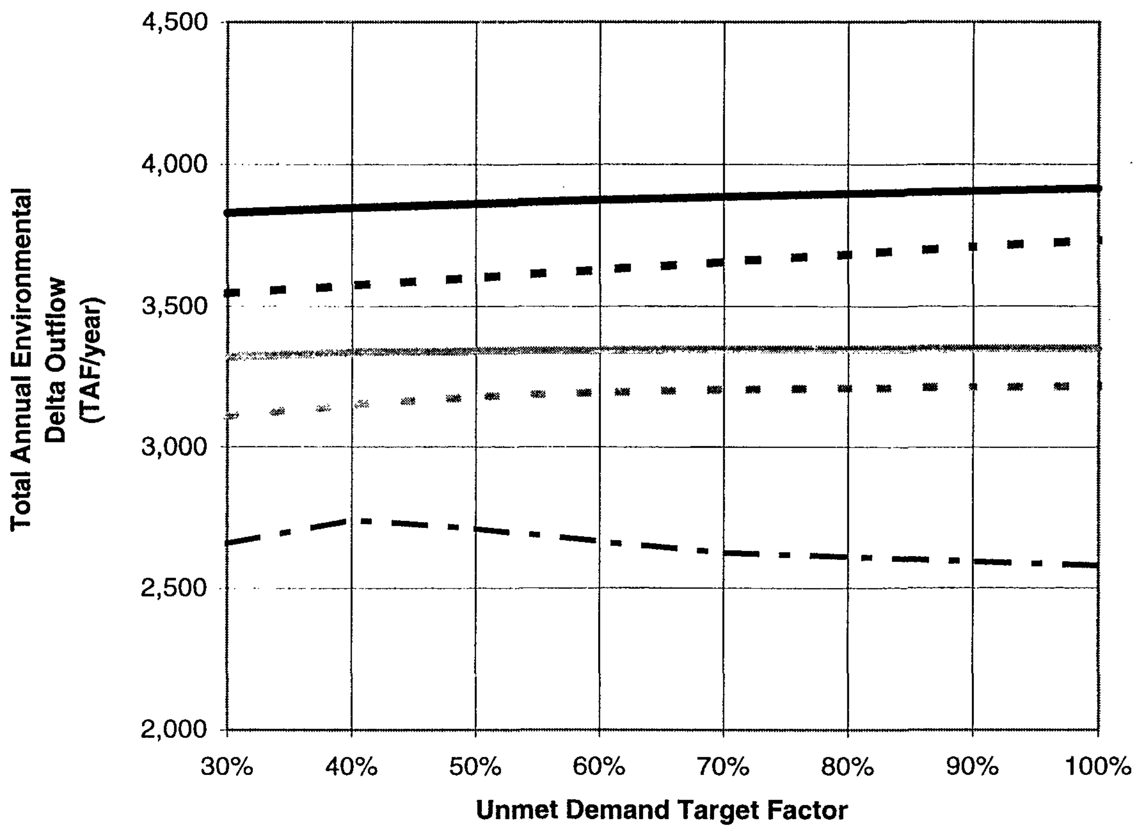
Total Water Supply Benefits (TAF/yr)

Unmet Demand Target:	30%	100%
71-Year Average:	3,828	3,918
1928-34 Dry Period Average:	3,320	3,357
Average of all Dry Years:	3,547	3,720
Average of all Crit. Dry Years:	3,111	3,259
Minimum Annual:	2,656	2,505

SE_UD7.XLS: XY-Tot Chart 1

Figure SE-26

South of Delta Off-Aqueduct Storage Environmental Water Supply Benefits versus Unmet Demand Target Factor



Assumptions
Storage Volume = 2.0 MAF
Conveyance Capacity = 3,500 cfs
SDI Banks PP Capacity
Env. Storage Carryover Factor = 50%
Unmet Demand Target Factor = Varies
Jan-Jun Delta Outflow Target = 9,000 cfs

71-Year Average
1928-34 Dry Period Average
Dry Year Average
Critically Dry Year Average
Minimum Annual

Total Water Supply Benefits (TAF/yr)

Unmet Demand Target:	30%	100%
71-Year Average:	3,828	3,914
1928-34 Dry Period Average:	3,320	3,350
Average of all Dry Years:	3,547	3,732
Average of all Crit. Dry Years:	3,111	3,216
Minimum Annual:	2,656	2,577

SE_UD8.XLS: XY-Tot Chart 1

Selection of Bracketing Operational Parameter Sets

As described in the previous sections, sensitivity analyses were conducted using the CALFED spreadsheet operations model to identify the effects of various operational parameters on environmental water supply benefits. Using the information developed through this process, parameter sets were selected to represent the four bracketing operation conditions described in Table SE-1.

Parameter sets which maximized 71-year Average Annual Environmental Delta Outflow were chosen for the Normal Period Supply Operation conditions. Emphasizing this long-term average clearly results in the largest quantity of total water supply deliveries over the 71-year hydrologic period. Developing a rational for selecting parameter sets for Dry Period Supply Operation conditions is more complex. Several sets of operational parameters resulted in relatively large Average Dry Year, Average Critically Dry Year, or 1928-34 Critical Dry Period Average Annual Environmental Delta Outflows. When examined in detail, however, it was found the large averages are often due to a particularly large storage release in one or two years, while no benefits are provided during many other critical years. Because of this, parameter sets which maximized Minimum Annual Environmental Delta Outflow were selected for the Dry Period Supply Operation conditions.

Parameter sets for Normal Period Supply Operation and Dry Period Supply Operation were selected for the two external conditions considered in this evaluation, existing Banks Pumping Plant capacity and expanded Banks Pumping Plant capacity. The resulting parameter sets for each of the four bracketing operation conditions are detailed in Table SE-9.

Table SE-9

South of Delta Off-Aqueduct Storage Selected Parameter Sets for Bracketing Operational Conditons

Operational Condition	Parameter Sets
A. Existing Banks PP Capacity -- Normal Period Supply Operation	Existing Banks PP Capacity Storage Carryover Factor = 0% Unmet Demand Target Factor = 100% Jan-Jun Outflow Target = 15,000 cfs
B. Existing Banks PP Capacity -- Dry Period Supply Operation	Existing Banks PP Capacity Storage Carryover Factor = 50% Unmet Demand Target Factor = 30% Jan-Jun Outflow Target = 9,000 cfs
C. Expanded Banks PP Capacity -- Normal Period Supply Operation	SDI Banks PP Capacity Storage Carryover Factor = 0% Unmet Demand Target Factor = 100% Jan-Jun Outflow Target = 15,000 cfs
D. Expanded Banks PP Capacity -- Dry Period Supply Operation	SDI Banks PP Capacity Storage Carryover Factor = 0% Unmet Demand Target Factor = 50% Jan-Jun Outflow Target = 9,000 cfs

SE_RVSM.XLS: Conditions Table

Comparison of Bracketing Operation Conditions

Model Runs

Model runs were completed for each of the four operation conditions using the parameter sets described in Table SE-9. For comparative purposes, maximum storage volume was set at 2.0 maf with a 3,500 cfs inflow/outflow capacity. Table SE-10 compares the total and net increased Environmental Delta Outflow under each operation condition.

Evaluation

The Normal Period Supply and Dry period Supply Operation conditions bracket the range of potential storage operations. Normal Period Supply Operation maximizes total average water supply benefits, as measured by the 71-Year Average Annual Environmental Delta Outflow. Dry Period Supply Operation maximizes water supply benefits in extremely dry years, as measured by the Minimum Annual Environmental Delta Outflow. Contrasting these bracketing operations for the existing Banks Pumping Plant capacity condition, Normal Period Supply Operation (Condition A) results in a net benefit of 150 taf in 71-Year Average Annual Environmental Delta Outflow, as compared to a net benefit of 50 taf under Dry Period Supply Operation (Condition B). Conversely, Dry Period Supply Operation (Condition B) results in a net benefit of 50 taf in Minimum Annual Environmental Delta Outflow, compared to a net benefit of 0 taf in Minimum Annual Environmental Delta Outflow under Normal Period Supply Operation (Condition A).

More significant benefits are achieved under the expanded Banks Pumping Plant capacity conditions. Contrasting the bracketing Operation Conditions C and D, Normal period Supply Operation (Condition C) results in a net benefit of 270 taf in 71-Year Average Annual Environmental Delta Outflow, as compared to a net benefit of 90 taf under Dry Period Supply Operation (Condition D). Conversely, Dry Period Supply Operation results in a net benefit of 50 taf in Minimum Annual Environmental Delta Outflow, compared to a net benefit of 0 taf in Minimum Annual Environmental Delta Outflow under Normal Period Supply Operation.

Figures SE-27 and SE-28 compare the relative effects of the four operation conditions on an annual basis. In these charts, bars represent the total Environmental Delta Outflow for the 71 years used in the model simulations, sorted from minimum to maximum. For comparison, base case Environmental Delta Outflow is represented with a line in each chart. Figure SE-27 compares Normal Period Supply and Dry Period Supply Operations (Conditions A & B) for the existing Banks Pumping Plant capacity condition. While minor benefits are seen during the driest years under Dry Period Supply Operation (Condition B), benefits during average-type water years is significantly reduced. Similarly, Figure SE-28 compares Normal Period Supply and Dry Period Supply Operations (Conditions C & D) for the expanded Banks Pumping Plant capacity condition. More significant benefits occur during the very driest years under Dry Period Supply Operation (Condition D); however, benefits during average-type water years are once again significantly reduced in comparison to Normal Period Supply Operation (Condition C).

Figure SE-29 presents the same data used in Figures SE-27 and SE-28 in a frequency-of-exceedence format. In this chart, total annual Environmental Delta Outflow for the base case and the four operation conditions is plotted against frequency of exceedence. As described above, significantly higher benefits in average-type years are shown with Normal Period Supply Operation, with relatively smaller net gains in drier years under Dry Period Supply Operation.

To provide a better understanding of the year-to-year operations that occur under the four bracketing operation conditions, Figures SE-30 through SE-33 display the simulated storage releases that occur throughout the 71-year hydrological sequence. In each chart, bars represent annual volumes of storage releases and a solid line represents the annual volume of water required to fully meet the Environmental Delta Outflow target of 12,000 cfs for January through June. For each operation condition, an operational Delta outflow target was chosen to control storage operations. A dashed line represents the annual volume of water required to meet this operational Delta outflow target. As can be seen in these charts, under Normal Period Supply Operations (Conditions A and C) larger annual volumes of water are released in relatively few years of the 71-year hydrologic sequence. Under Dry Period Supply Operations (Conditions B and D), annual releases are much smaller, but occur on a much more frequent basis.

Simulated end-of-month storage volumes for the four bracketing operation conditions are shown in Figures SE-34 through SE-37. As expected, storage volumes show much larger variability under Normal Period Supply Operations (Conditions A and C) in comparison to Dry Period Supply Operations (Conditions B and D). Under Condition A (Existing Banks Pumping Plant -- Normal Period Supply Operation), the maximum storage volume of 2.0 maf is reached in only one year of the 71-year hydrologic sequence. Contrarily, under Condition D (Expanded Banks Pumping Plant Capacity -- Dry Period Supply Operation), the 2.0 maf storage volume remains mostly full over much of the 71-year hydrologic sequence.

Table SE-10

South of Delta Off-Aqueduct Storage
Environmental Delta Outflow vs. Operational Condition
for 2.0 MAF Maximum Storage Capacity

(Values in thousands of acre-feet)

Environmental Delta Outflow	Base 1	Base 1	Operation Condition A SE208		Operation Condition B SE219		Operation Condition C SE230		Operation Condition D SE241	
	Base Case with Existing Banks PP Capacity	Base Case with SDI Banks PP Capacity	Environ. Delta Outflow	Net Benefit	Environ. Delta Outflow	Net Benefit	Environ. Delta Outflow	Net Benefit	Environ. Delta Outflow	Net Benefit
71-Year Average	3,774	3,774	3,924	150	3,821	47	4,038	264	3,860	86
1928-34 Dry Period Average	3,249	3,249	3,270	22	3,290	42	3,334	85	3,345	96
Dry Year Average	3,484	3,484	3,713	229	3,563	79	3,899	415	3,603	119
Critically Dry Year Average	2,942	2,942	2,974	32	3,051	109	3,165	223	3,189	247
Minimum Annual	2,410	2,410	2,410	0	2,460	50	2,410	0	2,814	404

[1] See Table SE-9 for description of operational conditions.

Figure SE-27

South of Delta Off-Aqueduct Storage
Environmental Water Supply Benefits Under a Range of Operational Conditions

A. Existing Banks PP Capacity -- Normal Period Supply Operation

B. Existing Banks PP Capacity -- Dry Period Supply Operation

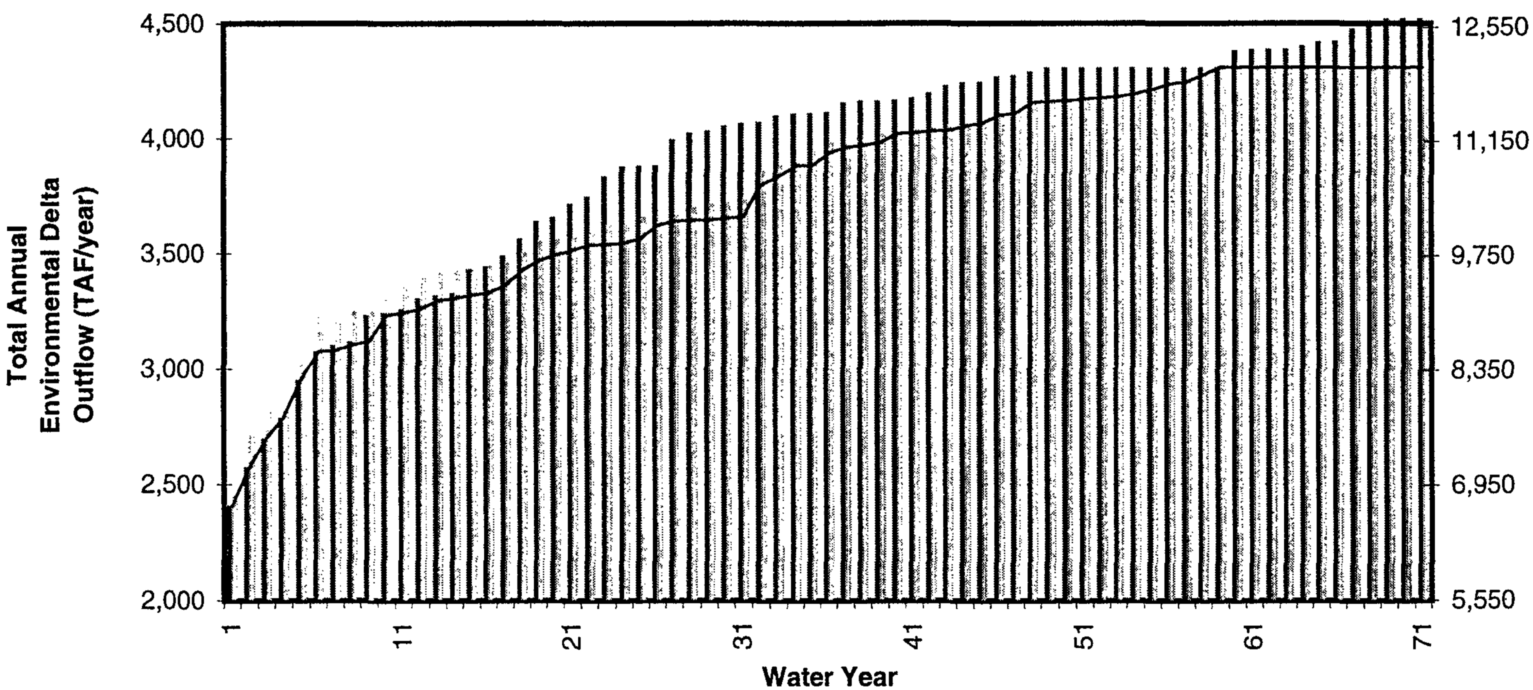
Base Case (No Storage, Existing Banks Cap.)

Assumptions

Maximum Storage Capacity = 2.0 MAF
Conveyance Capacity = 3,500 cfs

Total Water Supply Benefits (TAF/yr)

Operation Condition:	A	B
71-Year Average:	3,924	3,821
1928-34 Dry Period Average:	3,270	3,290
Average of all Dry Years:	3,713	3,563
Average of all Crit. Dry Years:	2,974	3,051
Minimum Annual:	2,410	2,460



SE_OP1.XLS: Sort-Tot Chart 1

Figure SE-28

South of Delta Off-Aqueduct Storage
Environmental Water Supply Benefits Under a Range of Operational Conditions

C. Expanded Banks PP Capacity -- Normal Period Supply Operation

D. Expanded Banks PP Capacity -- Dry Period Supply Operation

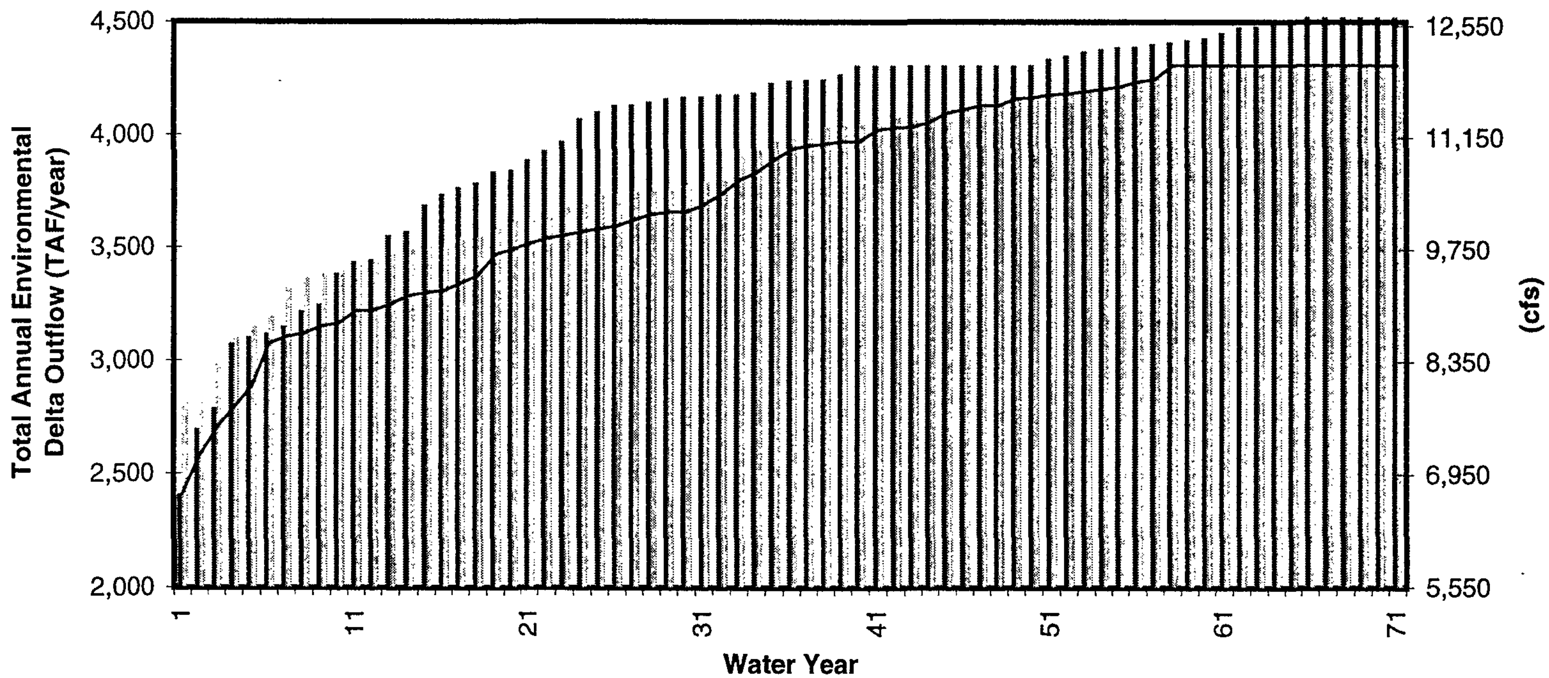
Base Case (No Storage, SDI Banks Cap.)

Assumptions

Maximum Storage Capacity = 2.0 MAF
Conveyance Capacity = 3,500 cfs

Total Water Supply Benefits (TAF/yr)

Operation Condition:	C	D
71-Year Average:	4,038	3,860
1928-34 Dry Period Average:	3,334	3,345
Average of all Dry Years:	3,899	3,603
Average of all Crit. Dry Years:	3,165	3,189
Minimum Annual:	2,410	2,814

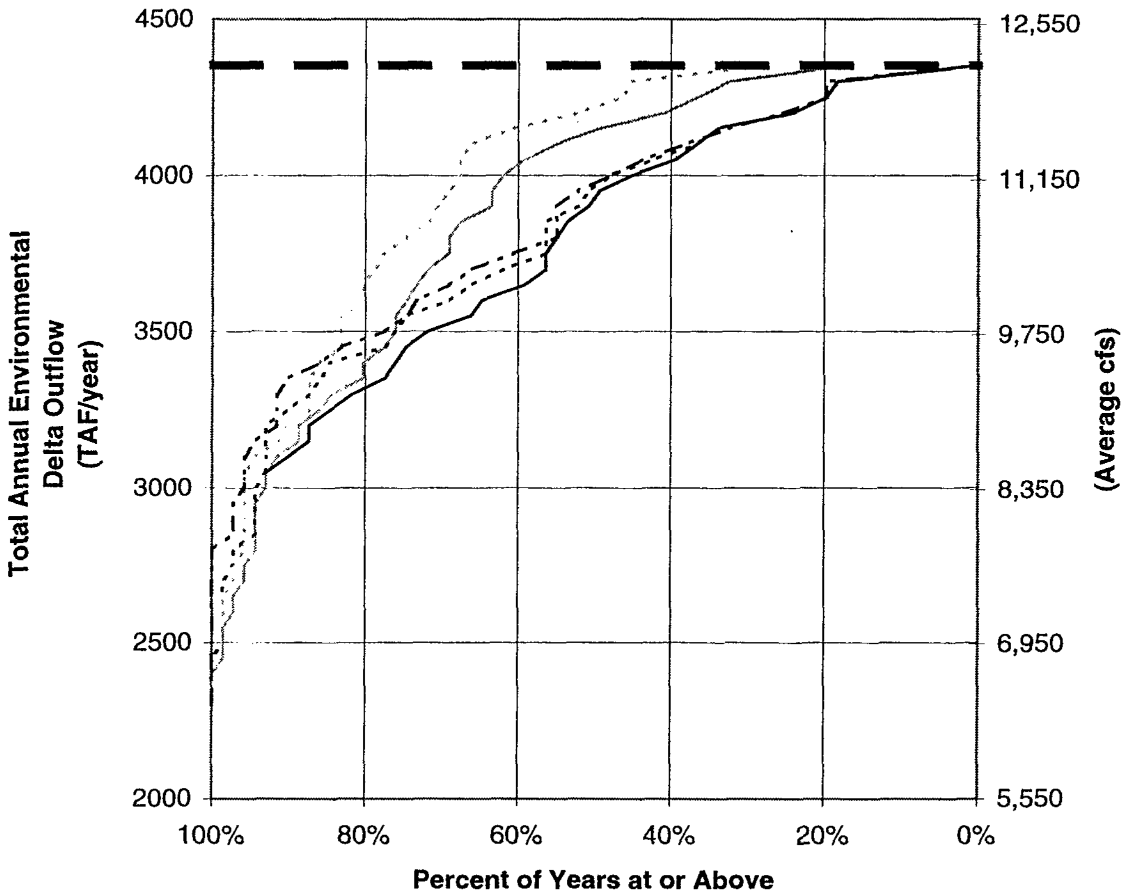


SE_OP1.XLS: Sort-Tot Chart 2

Preliminary Draft -- 7 March 1997

Figure SE-29

South of Delta Off-Aqueduct Storage Environmental Water Supply Benefits Under a Range of Operational Conditions



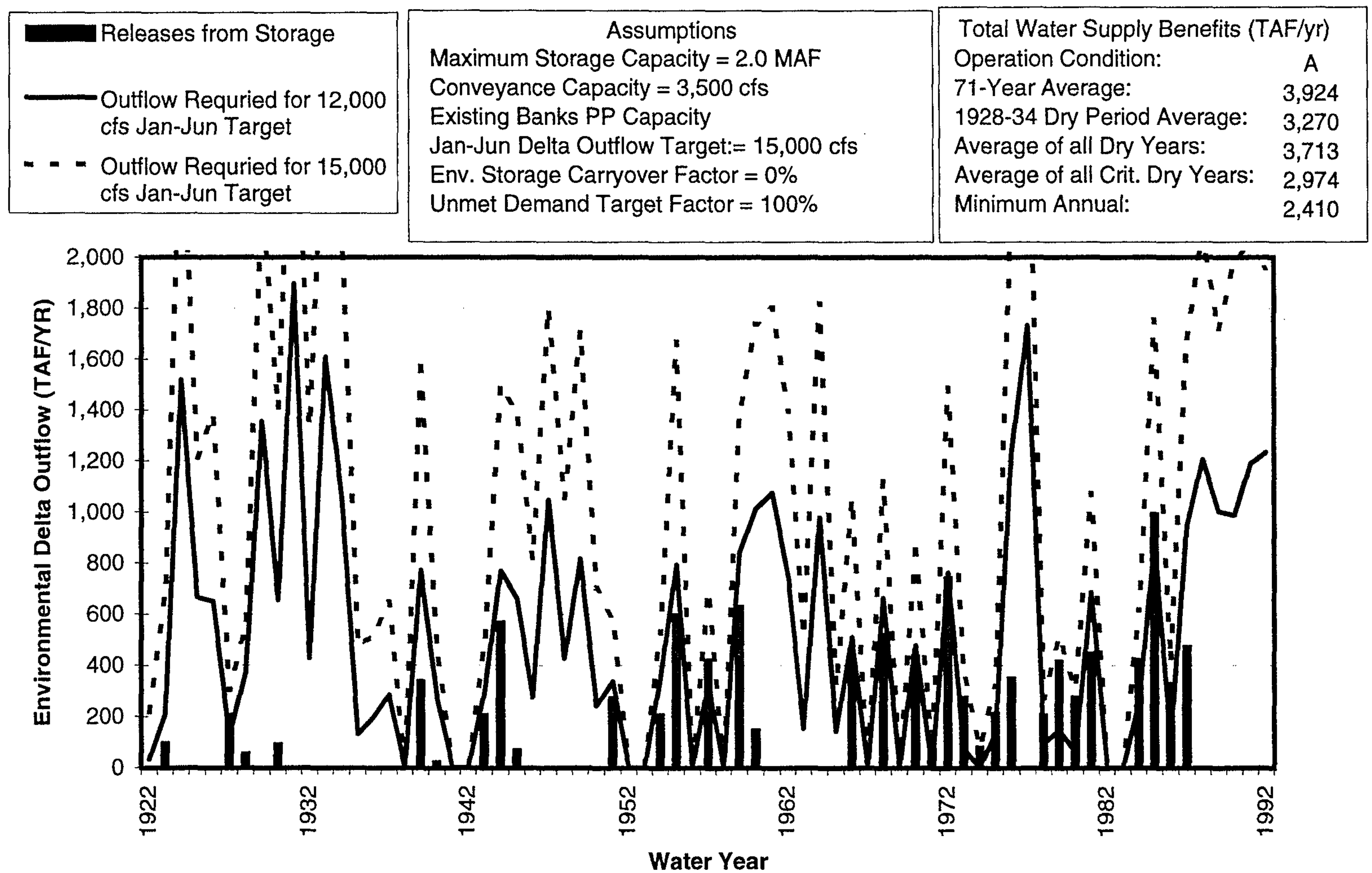
Assumptions	Total Water Supply Benefits (TAF/yr)				
Maximum Storage Capacity = 2.0 MAF	Operation Condition:	A	B	C	D
Conveyance Capacity = 3,500 cfs	71-Year Average:	3,924	3,821	4,038	3,860
	1928-34 Dry Period Average:	3,270	3,290	3,334	3,345
	Average of all Dry Years:	3,713	3,563	3,899	3,603
	Average of all Crit. Dry Years:	2,974	3,051	3,165	3,189
	Minimum Annual:	2,410	2,460	2,410	2,814

——— Base Case (No Storage, Existing Banks Cap.)
——— A. Existing Banks PP Capacity -- Normal Period Supply Operation
- - - - - - B. Existing Banks PP Capacity -- Dry Period Supply Operation
- - - - - - C. Expanded Banks PP Capacity -- Normal Period Supply Operation
— - — - D. Expanded Banks PP Capacity -- Dry Period Supply Operation
▬ '12,000 cfs Target

SE_OP1.XLS: Freq-Tot Chart 1

Figure SE-30

South of Delta Off-Aqueduct Storage
Environmental Water Supply Benefits Under Operations Condition A
Existing Banks PP Capacity -- Normal Period Supply Operations



SE_OP1.XLS: Outflow Plot A

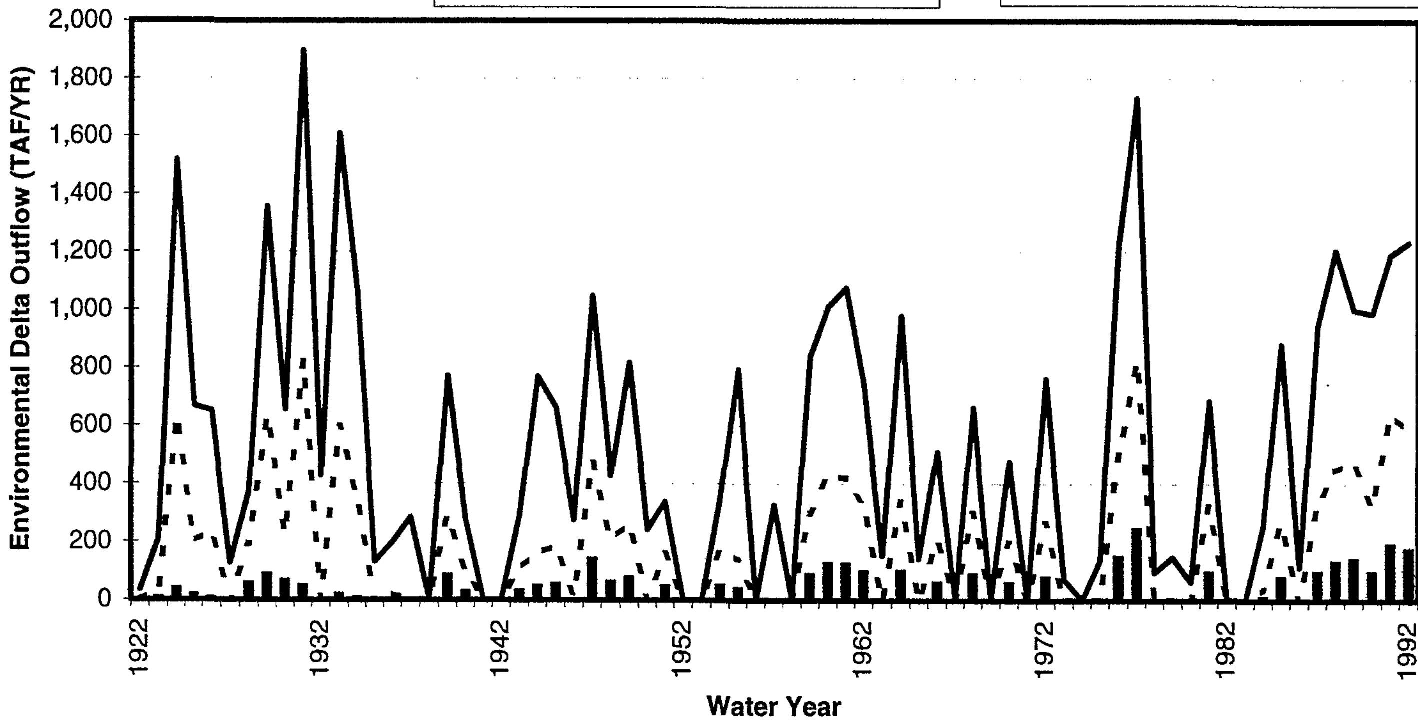
Figure SE-31

South of Delta Off-Aqueduct Storage
Environmental Water Supply Benefits Under Operations Condition B
Existing Banks PP Capacity -- Dry Period Supply Operations

Releases from Storage
Outflow Requried for 12,000 cfs Jan-Jun Target
Outflow Requried for 9,000 cfs Jan-Jun Target

Assumptions
Maximum Storage Capacity = 2.0 MAF
Conveyance Capacity = 3,500 cfs
Existing Banks PP Capacity
Jan-Jun Delta Outflow Target:= 9,000 cfs
Env. Storage Carryover Factor = 50%
Unmet Demand Target Factor = 30%

Total Water Supply Benefits (TAF/yr)	
Operation Condition:	B
71-Year Average:	3,821
1928-34 Dry Period Average:	3,290
Average of all Dry Years:	3,563
Average of all Crit. Dry Years:	3,051
Minimum Annual:	2,460



SE_OP1.XLS: Outflow Plot B

Figure SE-32

South of Delta Off-Aqueduct Storage
Environmental Water Supply Benefits Under Operations Condition C
Expanded Banks PP Capacity -- Normal Period Supply Operations

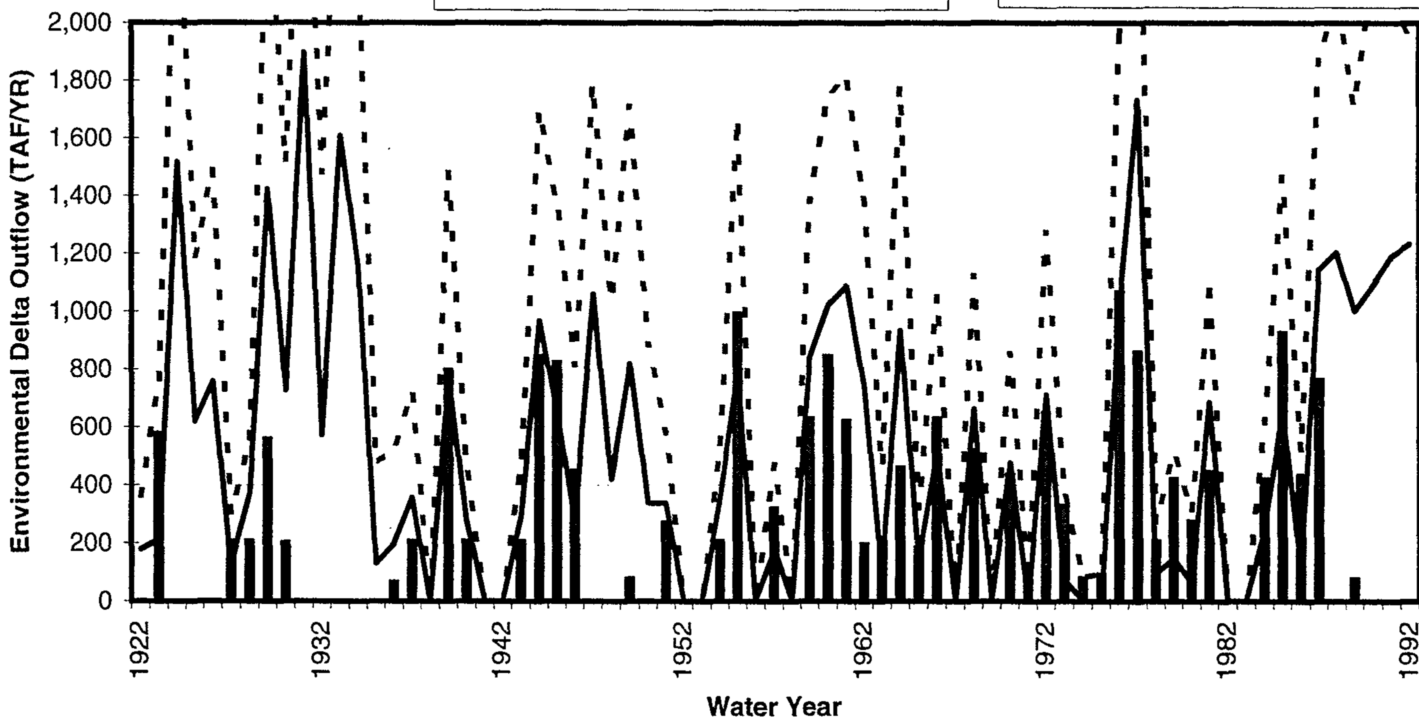
Releases from Storage

Outflow Requried for 12,000 cfs Jan-Jun Target

Outflow Requried for 15,000 cfs Jan-Jun Target

Assumptions
Maximum Storage Capacity = 2.0 MAF
Conveyance Capacity = 3,500 cfs
SDI Banks PP Capacity
Jan-Jun Delta Outflow Target:= 15,000 cfs
Env. Storage Carryover Factor = 0%
Unmet Demand Target Factor = 100%

Total Water Supply Benefits (TAF/yr)	
Operation Condition:	C
71-Year Average:	4,038
1928-34 Dry Period Average:	3,334
Average of all Dry Years:	3,899
Average of all Crit. Dry Years:	3,165
Minimum Annual:	2,410



SE_OP1.XLS: Outflow Plot C

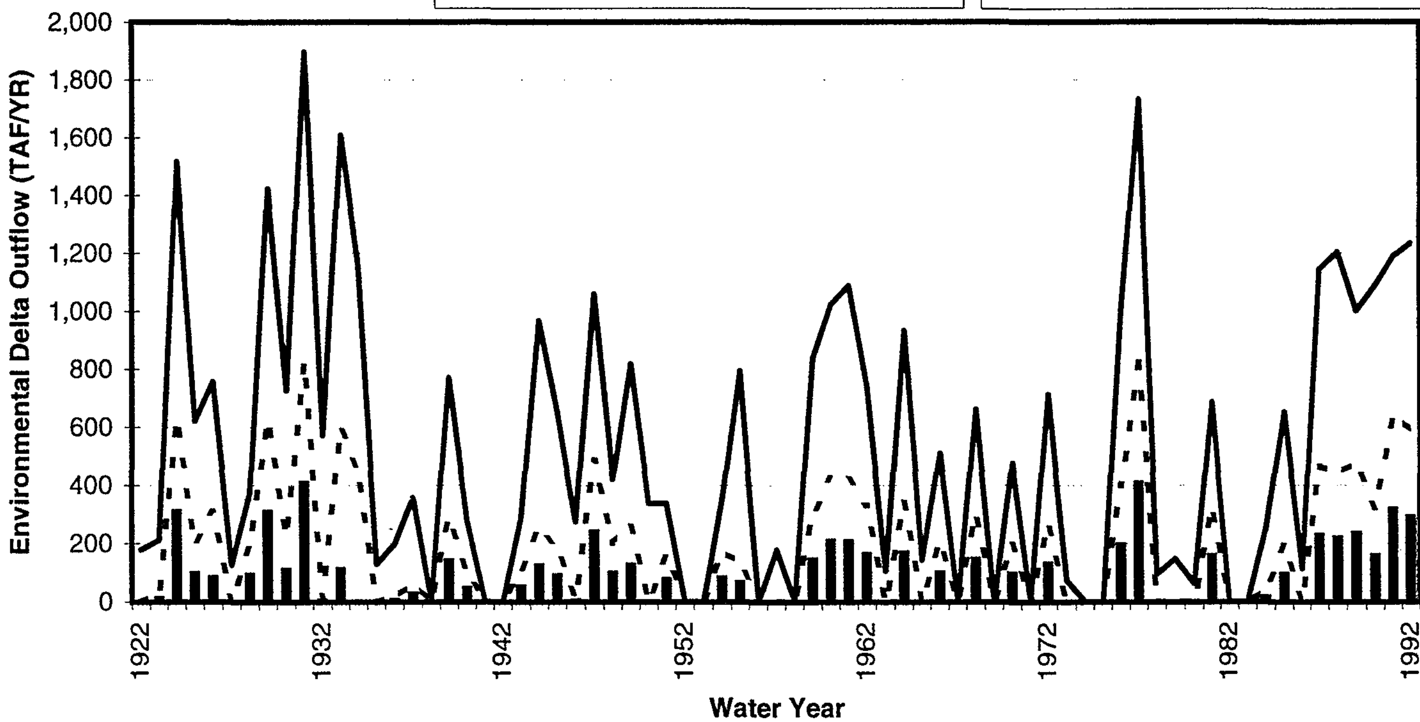
Figure SE-33

South of Delta Off-Aqueduct Storage
Environmental Water Supply Benefits Under Operations Condition D
Expanded Banks PP Capacity -- Dry Period Supply Operations

Releases from Storage
Outflow Requried for 12,000 cfs Jan-Jun Target
Outflow Requried for 9,000 cfs Jan-Jun Target

Assumptions
Maximum Storage Capacity = 2.0 MAF
Conveyance Capacity = 3,500 cfs
SDI Banks PP Capacity
Jan-Jun Delta Outflow Target:= 9,000 cfs
Env. Storage Carryover Factor = 0%
Unmet Demand Target Factor = 50%

Total Water Supply Benefits (TAF/yr)	
Operation Condition:	D
71-Year Average:	3,860
1928-34 Dry Period Average:	3,345
Average of all Dry Years:	3,603
Average of all Crit. Dry Years:	3,189
Minimum Annual:	2,814

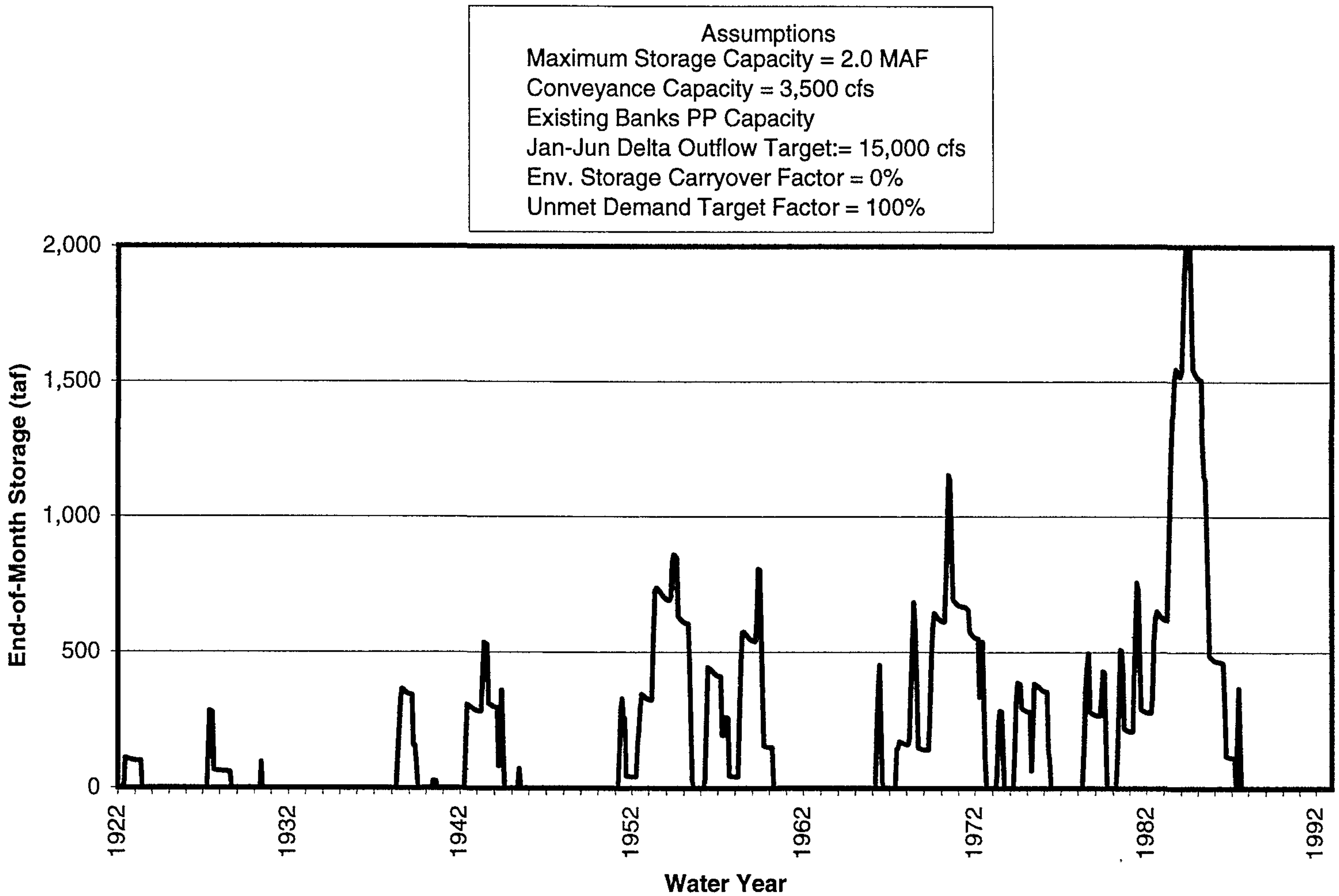


SE_OP1.XLS: Outflow Plot D

D-005577

Figure SE-34

South of Delta Off-Aqueduct Storage
End-of-Month Storage Volume Under Operations Condition A
Existing Banks PP Capacity -- Normal Period Supply Operations

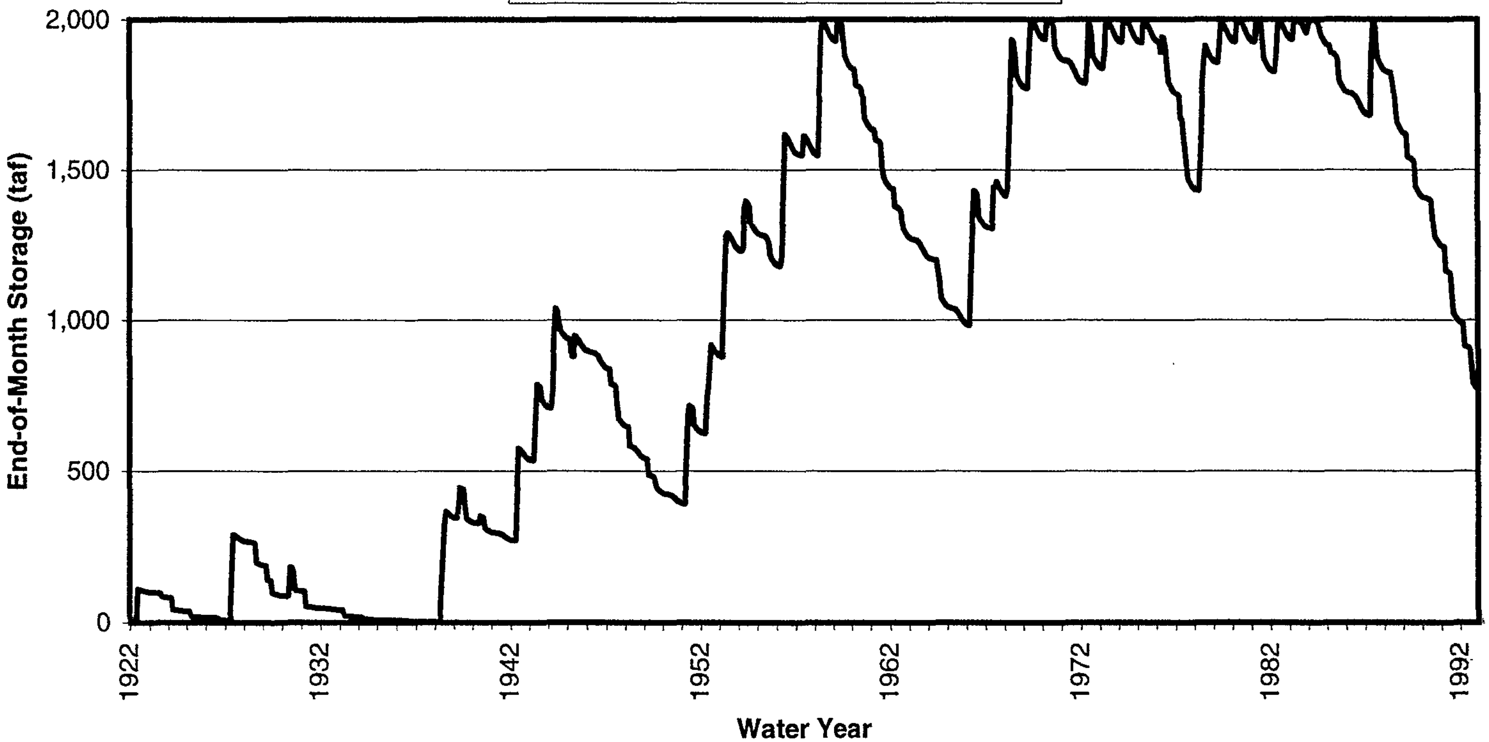


SE_OP1.XLS: EOM Storage A

Figure SE-35

South of Delta Off-Aqueduct Storage
End-of-Month Storage Volume Under Operations Condition B
Existing Banks PP Capacity -- Dry Period Supply Operations

Assumptions
Maximum Storage Capacity = 2.0 MAF
Conveyance Capacity = 3,500 cfs
Existing Banks PP Capacity
Jan-Jun Delta Outflow Target:= 9,000 cfs
Env. Storage Carryover Factor = 50%
Unmet Demand Target Factor = 30%



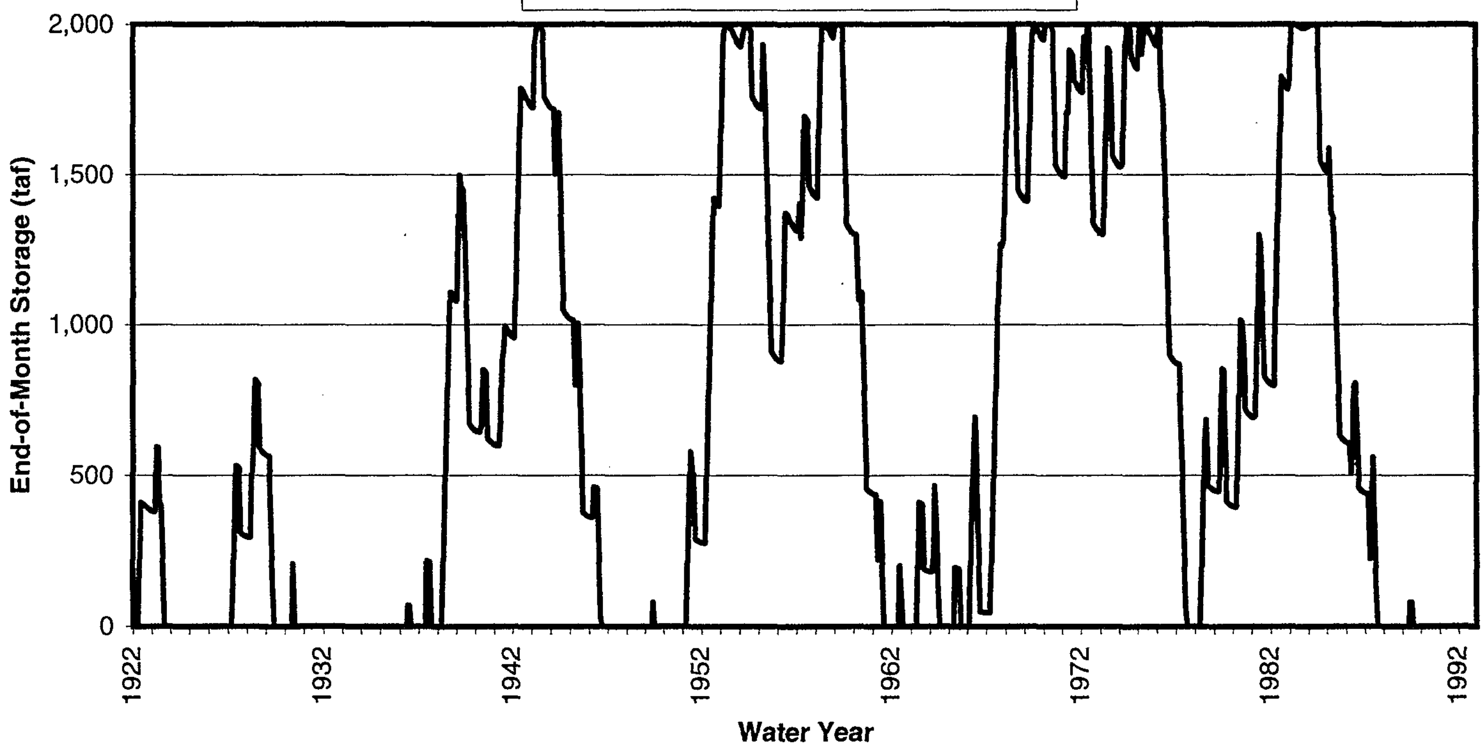
SE_OP1.XLS: EOM Storage B

D-005579

Figure SE-36

South of Delta Off-Aqueduct Storage
End-of-Month Storage Volume Under Operations Condition C
Expanded Banks PP Capacity -- Normal Period Supply Operations

Assumptions
Maximum Storage Capacity = 2.0 MAF
Conveyance Capacity = 3,500 cfs
SDI Banks PP Capacity
Jan-Jun Delta Outflow Target:= 15,000 cfs
Env. Storage Carryover Factor = 0%
Unmet Demand Target Factor = 100%



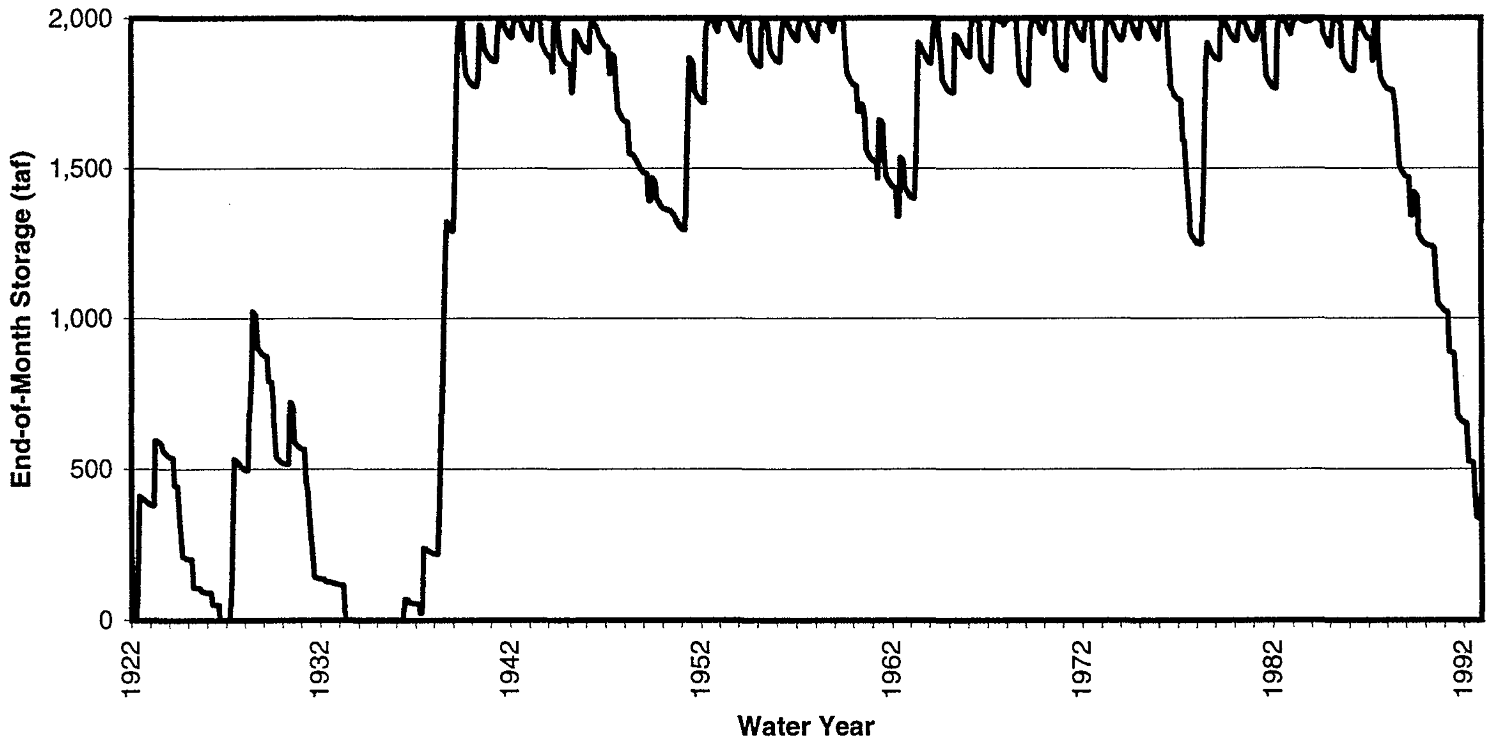
SE_OP1.XLS: EOM Storage C

Figure SE-37

South of Delta Off-Aqueduct Storage
End-of-Month Storage Volume Under Operations Condition D
Expanded Banks PP Capacity -- Dry Period Supply Operations

Assumptions

Maximum Storage Capacity = 2.0 MAF
Conveyance Capacity = 3,500 cfs
SDI Banks PP Capacity
Jan-Jun Delta Outflow Target:= 9,000 cfs
Env. Storage Carryover Factor = 0%
Unmet Demand Target Factor = 50%



SE_OP1.XLS: EOM Storage D

Water Supply Benefits versus Maximum Storage Volume

Model Runs

Maximum storage volumes ranging from 100 taf to 2.0 maf were varied in a set of model runs that simulated the four bracketing operation conditions described previously. These model runs are described in Table SE-11 and summary results are displayed in Tables SE-12 and SE-13. For comparability, all results are measured using the Environmental Delta Outflow criteria (average of January through June monthly Delta outflows up to 12,000 cfs) described previously.

Evaluation

Table SE-12 displays the five statistical measures of total Environmental Delta Outflow achieved over the range of maximum storage volumes studied for each of the bracketing operation conditions. Table SE-13 displays net increases in Environmental Delta Outflow for the same range of maximum storage volumes and operation conditions. Figures SE-38 through SE-42 display plots of total Environmental Delta Outflow versus maximum storage volumes. Figures SE-43 through SE-47 display plots of net increases in Environmental Delta Outflow. The wide range of benefits seen in these plots between operation conditions for any given maximum reservoir volume confirms that operation conditions must be more thoroughly defined before the maximum storage volume of south of Delta storage facilities can be optimized.

Figures SE-38 and SE-43 show that maximum 71-Year Average Annual Environmental Delta outflow is achieved under Condition C (Expanded Banks Pumping Plant Capacity -- Normal Period Supply Operation). Under this operating condition, 71-Year Average Annual Environmental Delta Outflow continues to increase with diminishing incremental benefit throughout the range of maximum storage volumes evaluated. With a maximum storage volume of 3.0 maf, the largest maximum storage volume evaluated, a net increase of 310 taf is observed in 71-Year Average Annual Environmental Delta Outflow. About 71 percent of this net benefit, a 220 taf increase in 71-Year Average Annual Environmental Delta Outflow, is achieved with a maximum storage volume of only 1.0 maf.

Under Condition A (Existing Banks Pumping Plant Capacity -- Normal Period Supply Operation), 71-Year Average Annual Environmental Delta Outflow also increases throughout the range of maximum storage volumes evaluated, but with much smaller incremental gains in comparison to Condition C. With a maximum storage volume of 3.0 maf, a net increase of 160 taf occurs in the 71-Year Average Annual Environmental Delta Outflow. About 72 percent of this net benefit, or 110 taf is achieved with a 500 taf maximum storage volume.

Figures SE-42 and SE-47 indicate that the largest Minimum Annual Environmental Delta Outflow is achieved under Condition D (Expanded Banks Pumping Plant Capacity -- Dry Period Supply Operation). Under this operating condition, Minimum Annual Environmental Delta Outflow increases dramatically between maximum storage volumes of 500 taf and 1.0 maf. A maximum net benefit of 400 taf in Minimum Annual Environmental Delta Outflow is observed with a maximum storage volume of 1.25 maf. Under Condition D, no additional Minimum Annual Environmental Delta Outflow is achieved with maximum storage volumes larger than 1.25 maf.

Under Condition B (Existing Banks Pumping Plant Capacity -- Dry Period Supply Operation), a net increase in Minimum Annual Environmental Delta Outflow of 50 taf is observed with a maximum storage volume of 500 taf. Under Condition B, no significant additional Environmental Delta Outflow benefits are achieved with maximum storage volumes larger than 500 taf.

Table SE-11

South of Delta Off-Aqueduct Storage
Model Runs for Evaluation of Maximum Storage Volume

Run Results Workbook	Evaluation Workbook	Model Run Identifiers	Maximum Reservoir Volume (taf)	Common Assumptions
OUT_SO4.XLS	SE_RV1.XLS	SE200	100	Existing Banks PP Capacity -- Normal Period Supply Operation
		SE201	250	3,500 cfs Inflow/Outflow Capacity
		SE202	500	Existing Banks PP Capacity
		SE203	750	Storage Carryover Factor = 0%
		SE204	1,000	Unmet Demand Target Factor = 100%
		SE205	1,250	Jan-Jun Outflow Target = 15,000 cfs
		SE206	1,500	
		SE207	1,750	
		SE208	2,000	
		SE209	2,500	
		SE210	3,000	
OUT_SO4.XLS	SE_RV2.XLS	SE211	100	Existing Banks PP Capacity -- Dry Period Supply Operation
		SE212	250	3,500 cfs Inflow/Outflow Capacity
		SE213	500	Existing Banks PP Capacity
		SE214	750	Storage Carryover Factor = 50%
		SE215	1,000	Unmet Demand Target Factor = 30%
		SE216	1,250	Jan-Jun Outflow Target = 9,000 cfs
		SE217	1,500	
		SE218	1,750	
		SE219	2,000	
		SE220	2,500	
		SE221	3,000	
OUT_SO4.XLS	SE_RV3.XLS	SE222	100	Expanded Banks PP Capacity -- Normal Period Supply Operation
		SE223	250	3,500 cfs Inflow/Outflow Capacity
		SE224	500	SDI Banks PP Capacity
		SE225	750	Storage Carryover Factor = 0%
		SE226	1,000	Unmet Demand Target Factor = 100%
		SE227	1,250	Jan-Jun Outflow Target = 15,000 cfs
		SE228	1,500	
		SE229	1,750	
		SE230	2,000	
		SE231	2,500	
		SE232	3,000	
OUT_SO4.XLS	SE_RV4.XLS	SE233	100	Expanded Banks PP Capacity -- Dry Period Supply Operation
		SE234	250	3,500 cfs Inflow/Outflow Capacity
		SE235	500	SDI Banks PP Capacity
		SE236	750	Storage Carryover Factor = 0%
		SE237	1,000	Unmet Demand Target Factor = 50%
		SE238	1,250	Jan-Jun Outflow Target = 9,000 cfs
		SE239	1,500	
		SE240	1,750	
		SE241	2,000	
		SE242	2,500	
		SE243	3,000	

SE_RVSM.XLS: Runs

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Table SE-12

South of Delta Off-Aqueduct Storage
Environmental Delta Outflow vs. Maximum Storage Volume
Under Various Operational Conditions[1]

(Values in thousands of acre-feet)

Operation Condition A. Existing Banks PP Capacity -- Normal Period Supply Operation

Run Identifiers:	Base 1	SE200	SE201	SE202	SE203	SE204	SE205	SE206	SE207	SE208	SE209	SE210	Maximum Total Value	Maximum Net Value	Maximum Increase (percent)
Max. Storage Volume (taf):	0	100	250	500	750	1,000	1,250	1,500	1,750	2,000	2,500	3,000			
71-Year Average	3,774	3,807	3,848	3,887	3,901	3,910	3,915	3,918	3,921	3,924	3,930	3,930	3,930	156	4.1%
1928-34 Dry Period Average	3,249	3,262	3,266	3,270	3,270	3,270	3,270	3,270	3,270	3,270	3,270	3,270	3,270	22	0.7%
Dry Year Average	3,484	3,514	3,554	3,615	3,652	3,677	3,692	3,706	3,706	3,713	3,736	3,736	3,736	253	7.2%
Critically Dry Year Average	2,942	2,950	2,963	2,974	2,974	2,974	2,974	2,974	2,974	2,974	2,979	2,979	2,979	37	1.2%
Minimum Annual	2,410	2,410	2,410	2,410	2,410	2,410	2,410	2,410	2,410	2,410	2,410	2,410	2,410	0	0.0%

Operation Condition B. Existing Banks PP Capacity -- Dry Period Supply Operation

Run Identifiers:	Base 1	SE211	SE212	SE213	SE214	SE215	SE216	SE217	SE218	SE219	SE220	SE221	Maximum Total Value	Maximum Net Value	Maximum Increase (percent)
Max. Storage Volume (taf):	0	100	250	500	750	1,000	1,250	1,500	1,750	2,000	2,500	3,000			
71-Year Average	3,774	3,791	3,802	3,811	3,816	3,819	3,820	3,821	3,821	3,821	3,821	3,821	3,821	47	1.2%
1928-34 Dry Period Average	3,249	3,270	3,286	3,290	3,290	3,290	3,290	3,290	3,290	3,290	3,290	3,290	3,290	42	1.3%
Dry Year Average	3,484	3,512	3,532	3,552	3,561	3,563	3,563	3,563	3,563	3,563	3,563	3,563	3,563	79	2.3%
Critically Dry Year Average	2,942	2,959	2,985	3,008	3,027	3,040	3,049	3,051	3,051	3,051	3,051	3,051	3,051	109	3.7%
Minimum Annual	2,410	2,423	2,452	2,460	2,460	2,460	2,460	2,460	2,460	2,460	2,460	2,460	2,460	50	2.1%

Operation Condition C. Expanded Banks PP Capacity -- Normal Period Supply Operation

Run Identifiers:	Base 1	SE222	SE223	SE224	SE225	SE226	SE227	SE228	SE229	SE230	SE231	SE232	Maximum Total Value	Maximum Net Value	Maximum Increase (percent)
Max. Storage Volume (taf):	0	100	250	500	750	1,000	1,250	1,500	1,750	2,000	2,500	3,000			
71-Year Average	3,774	3,825	3,886	3,938	3,968	3,986	4,000	4,013	4,025	4,038	4,062	4,075	4,075	301	8.0%
1928-34 Dry Period Average	3,249	3,222	3,258	3,291	3,325	3,334	3,334	3,334	3,334	3,334	3,334	3,334	3,334	85	2.6%
Dry Year Average	3,484	3,523	3,590	3,669	3,733	3,791	3,823	3,844	3,871	3,899	3,934	3,937	3,937	453	13.0%
Critically Dry Year Average	2,942	2,947	2,964	3,007	3,051	3,079	3,100	3,122	3,143	3,165	3,230	3,270	3,270	329	11.2%
Minimum Annual	2,410	2,410	2,410	2,410	2,410	2,410	2,410	2,410	2,410	2,410	2,410	2,410	2,410	0	0.0%

Operation Condition D. Expanded Banks PP Capacity -- Dry Period Supply Operation

Run Identifiers:	Base 1	SE233	SE234	SE235	SE236	SE237	SE238	SE239	SE240	SE241	SE242	SE243	Maximum Total Value	Maximum Net Value	Maximum Increase (percent)
Max. Storage Volume (taf):	0	100	250	500	750	1,000	1,250	1,500	1,750	2,000	2,500	3,000			
71-Year Average	3,774	3,802	3,822	3,839	3,848	3,854	3,857	3,859	3,860	3,860	3,860	3,860	3,860	86	2.3%
1928-34 Dry Period Average	3,249	3,222	3,256	3,287	3,315	3,343	3,345	3,345	3,345	3,345	3,345	3,345	3,345	96	3.0%
Dry Year Average	3,484	3,533	3,566	3,592	3,602	3,603	3,603	3,603	3,603	3,603	3,603	3,603	3,603	119	3.4%
Critically Dry Year Average	2,942	2,954	3,006	3,069	3,111	3,145	3,164	3,182	3,189	3,189	3,189	3,189	3,189	247	8.4%
Minimum Annual	2,410	2,410	2,492	2,533	2,699	2,796	2,814	2,814	2,814	2,814	2,814	2,814	2,814	404	16.7%

[1]See Table SE-9 for description of operational conditions.

SE_RVSM.XLS: Results (2)

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Table SE-13

South of Delta Off-Aqueduct Storage
Net Increase in Environmental Delta Outflow vs. Maximum Storage Volume
Under Various Operational Conditions[1]

(Values in thousands of acre-feet)

Operation Condition A. Existing Banks PP Capacity -- Normal Period Supply Operation											
Run Identifiers:	SE200	SE201	SE202	SE203	SE204	SE205	SE206	SE207	SE208	SE209	SE210
Max. Storage Volume (taf):	100	250	500	750	1,000	1,250	1,500	1,750	2,000	2,500	3,000
71-Year Average	33	74	113	127	136	141	144	147	150	156	156
1928-34 Dry Period Average	13	18	22	22	22	22	22	22	22	22	22
Dry Year Average	30	70	131	168	193	208	222	222	229	253	253
Critically Dry Year Average	8	21	32	32	32	32	32	32	32	37	37
Minimum Annual	0	0	0	0	0	0	0	0	0	0	0

Operation Condition B. Existing Banks PP Capacity -- Dry Period Supply Operation											
Run Identifiers:	SE211	SE212	SE213	SE214	SE215	SE216	SE217	SE218	SE219	SE220	SE221
Max. Storage Volume (taf):	100	250	500	750	1,000	1,250	1,500	1,750	2,000	2,500	3,000
71-Year Average	17	28	37	42	45	46	47	47	47	47	47
1928-34 Dry Period Average	21	38	42	42	42	42	42	42	42	42	42
Dry Year Average	28	48	68	77	79	79	79	79	79	79	79
Critically Dry Year Average	17	43	66	85	98	108	109	109	109	109	109
Minimum Annual	13	42	50	50	50	50	50	50	50	50	50

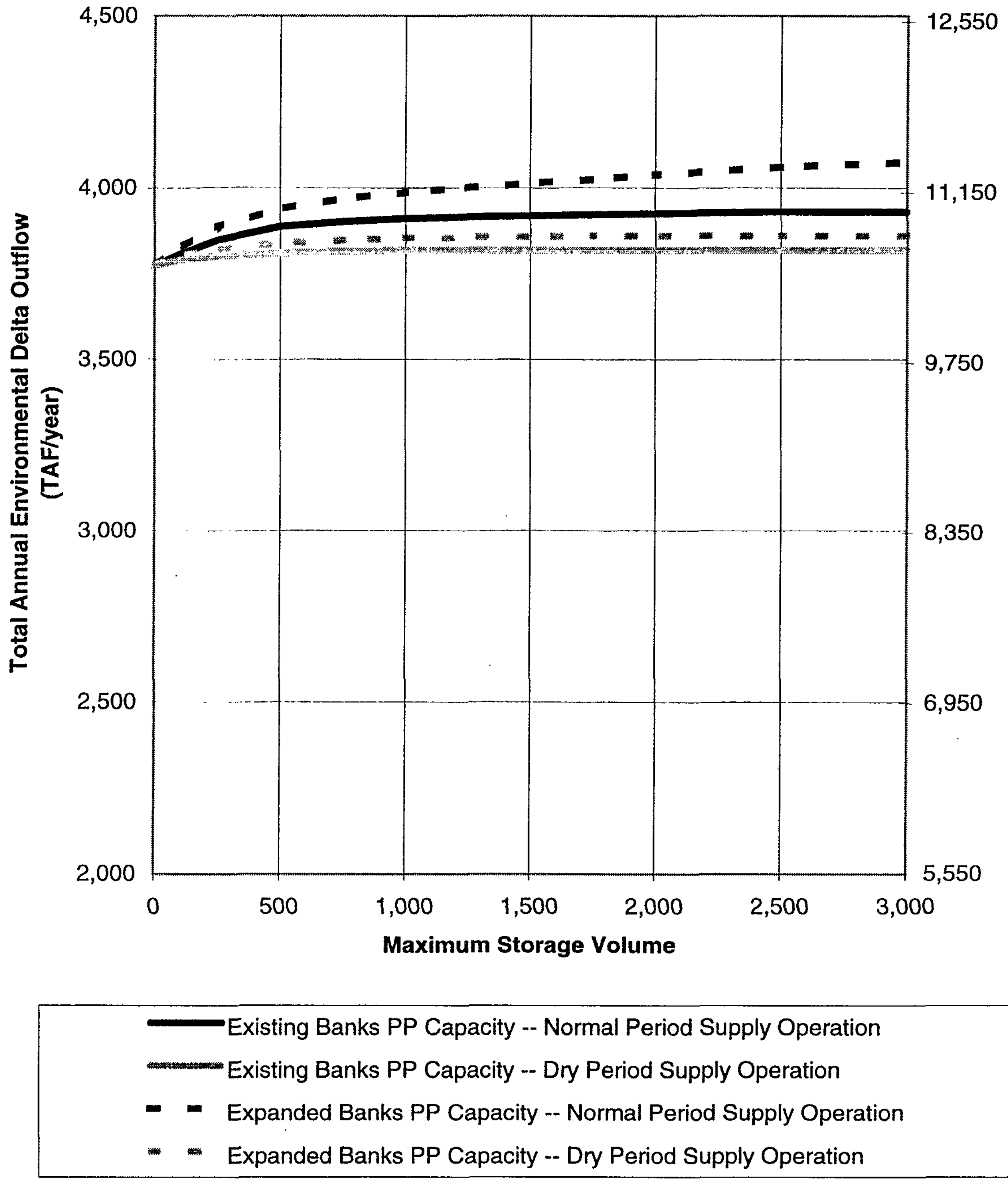
Operation Condition C. Expanded Banks PP Capacity -- Normal Period Supply Operation											
Run Identifiers:	SE222	SE223	SE224	SE225	SE226	SE227	SE228	SE229	SE230	SE231	SE232
Max. Storage Volume (taf):	100	250	500	750	1,000	1,250	1,500	1,750	2,000	2,500	3,000
71-Year Average	51	112	165	194	212	226	239	251	264	288	301
1928-34 Dry Period Average	-26	9	42	76	85	85	85	85	85	85	85
Dry Year Average	39	106	185	250	307	339	360	387	415	450	453
Critically Dry Year Average	6	22	65	109	137	158	180	201	223	288	329
Minimum Annual	0	0	0	0	0	0	0	0	0	0	0

Operation Condition D. Expanded Banks PP Capacity -- Dry Period Supply Operation											
Run Identifiers:	SE233	SE234	SE235	SE236	SE237	SE238	SE239	SE240	SE241	SE242	SE243
Max. Storage Volume (taf):	100	250	500	750	1,000	1,250	1,500	1,750	2,000	2,500	3,000
71-Year Average	28	48	65	74	80	83	85	86	86	86	86
1928-34 Dry Period Average	-27	7	38	67	94	96	96	96	96	96	96
Dry Year Average	49	82	108	118	119	119	119	119	119	119	119
Critically Dry Year Average	12	64	127	169	203	222	240	247	247	247	247
Minimum Annual	0	81	123	289	386	404	404	404	404	404	404

[1]See Table SE-9 for description of operational conditions.

Figure SE-38

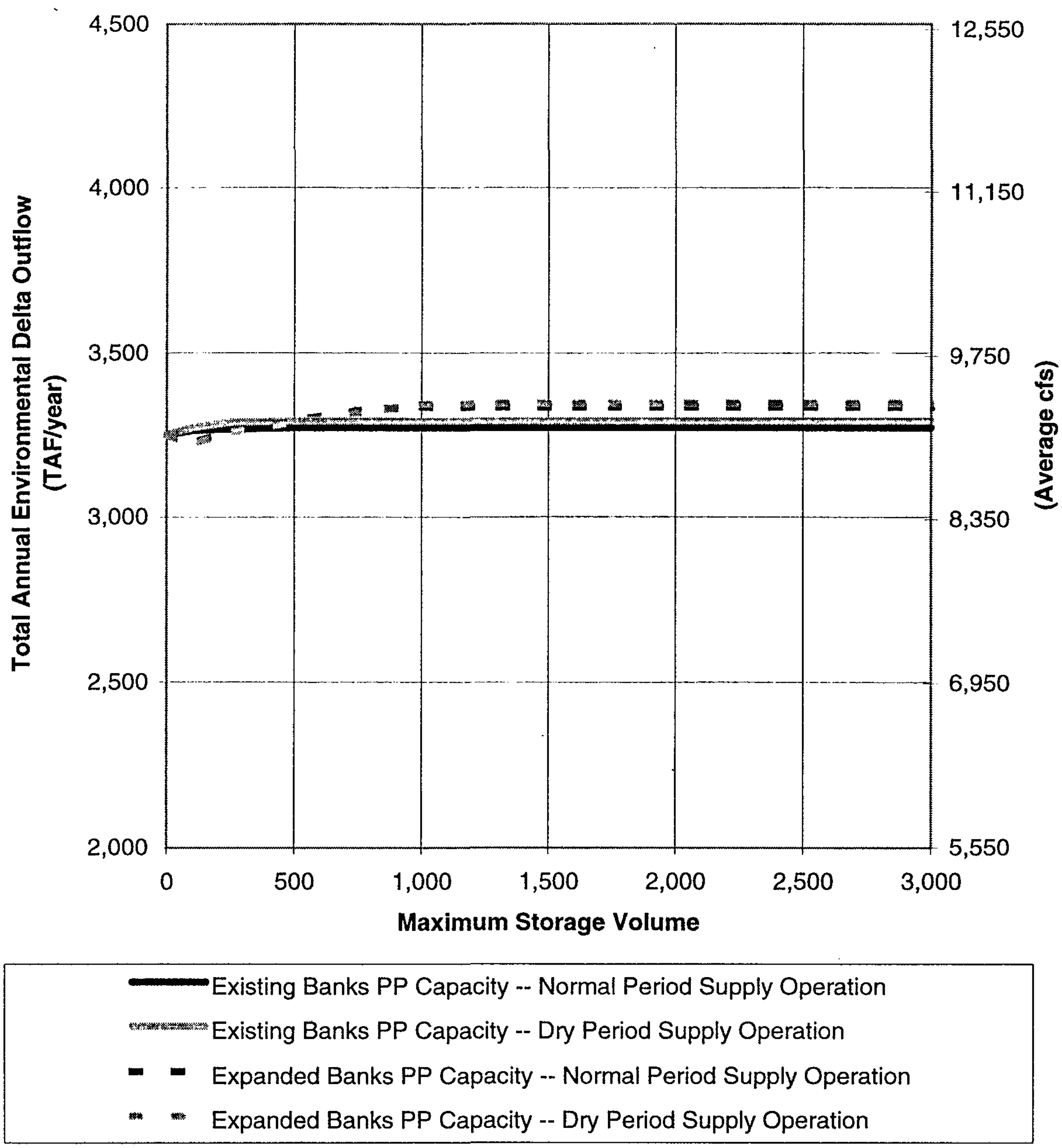
South of Delta Off-Aqueduct Storage
71-Year Average Environmental Delta Outflow
versus Maximum Storage Volume



SE_RVSM.XLS: 71-Yr Avg Chart

Figure SE-39

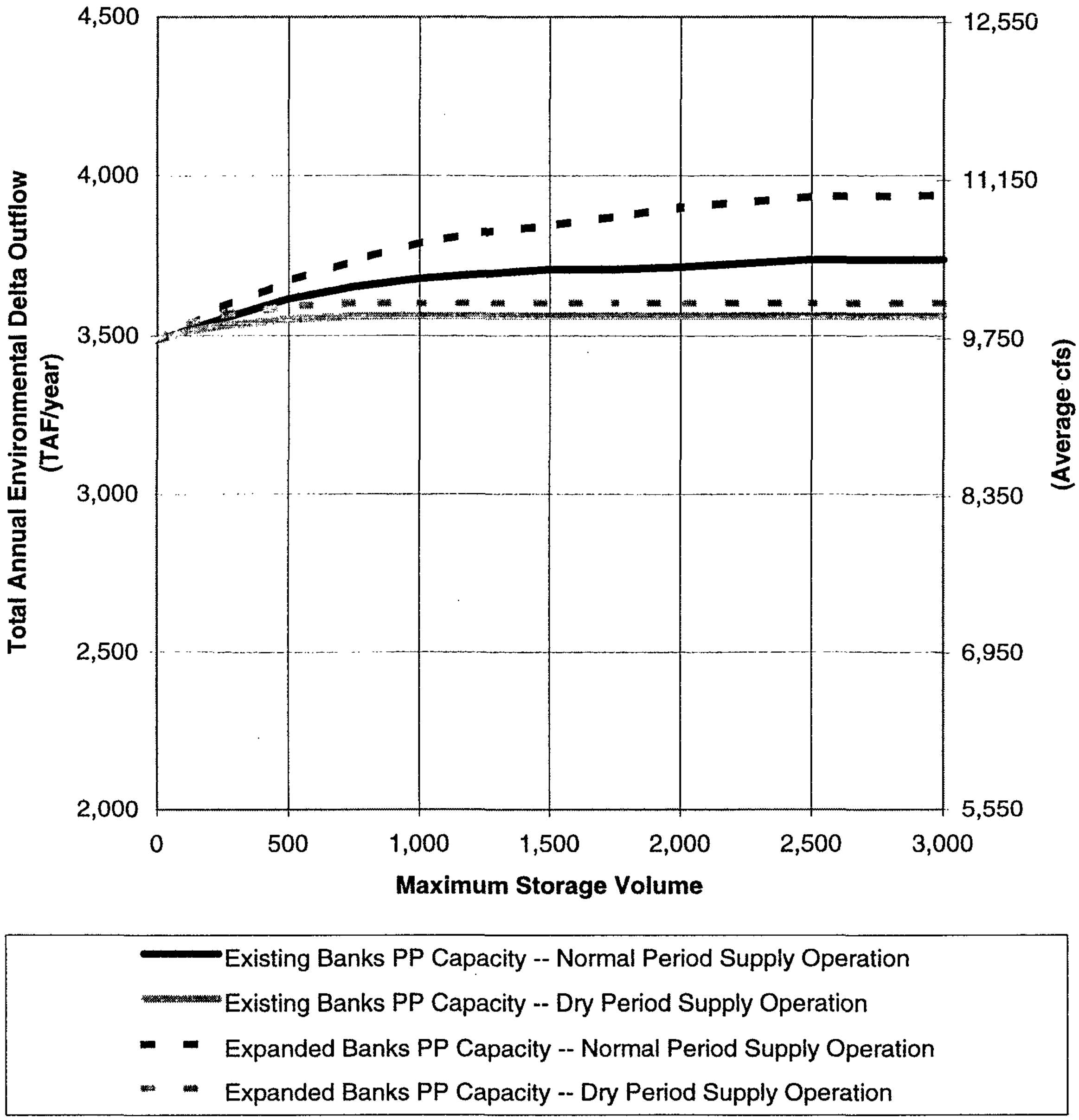
South of Delta Off-Aqueduct Storage
1928-34 Dry Period Annual Average Environmental Delta Outflow versus Maximum Storage Volume



SE_RVSM.XLS: 1928-34 Chart

Figure SE-40

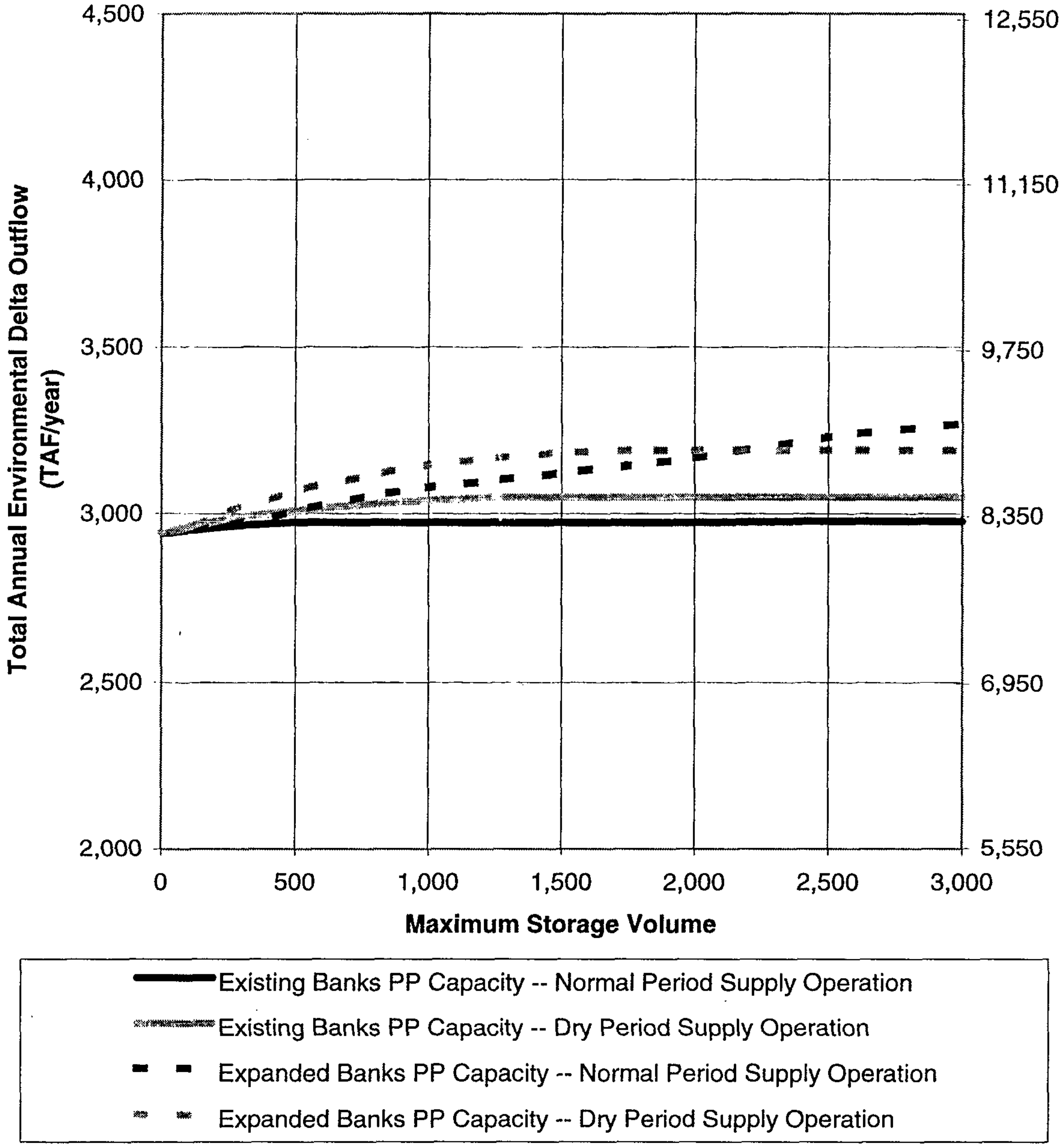
**South of Delta Off-Aqueduct Storage
Dry Year Average Environmental Delta Outflow
versus Maximum Storage Volume**



SE_RVSM.XLS: Dry Years Chart

Figure SE-41

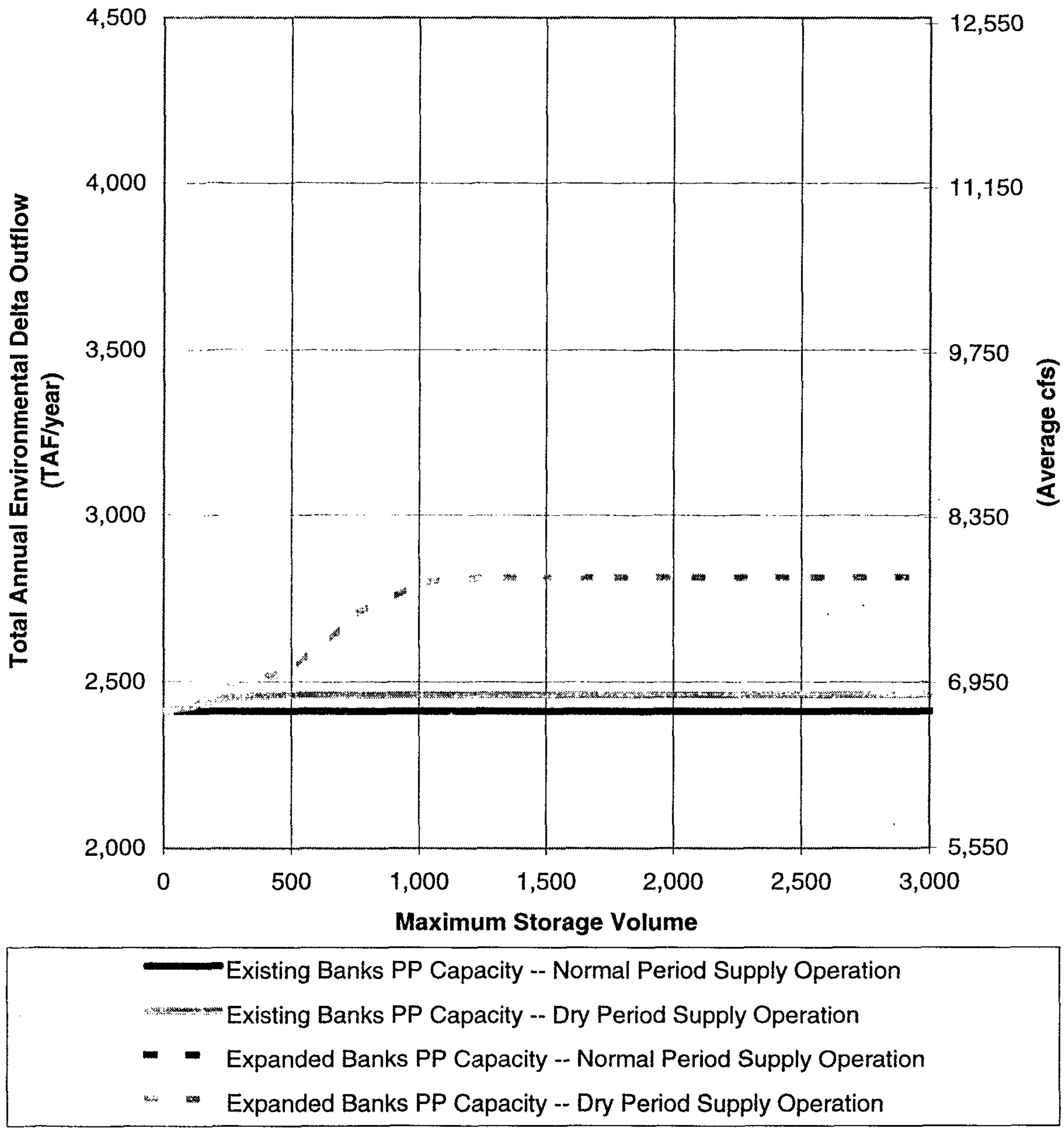
South of Delta Off-Aqueduct Storage
Critical Year Average Environmental Delta Outflow
versus Maximum Storage Volume



SE_RVSM.XLS: Crit Years Chart

Figure SE-42

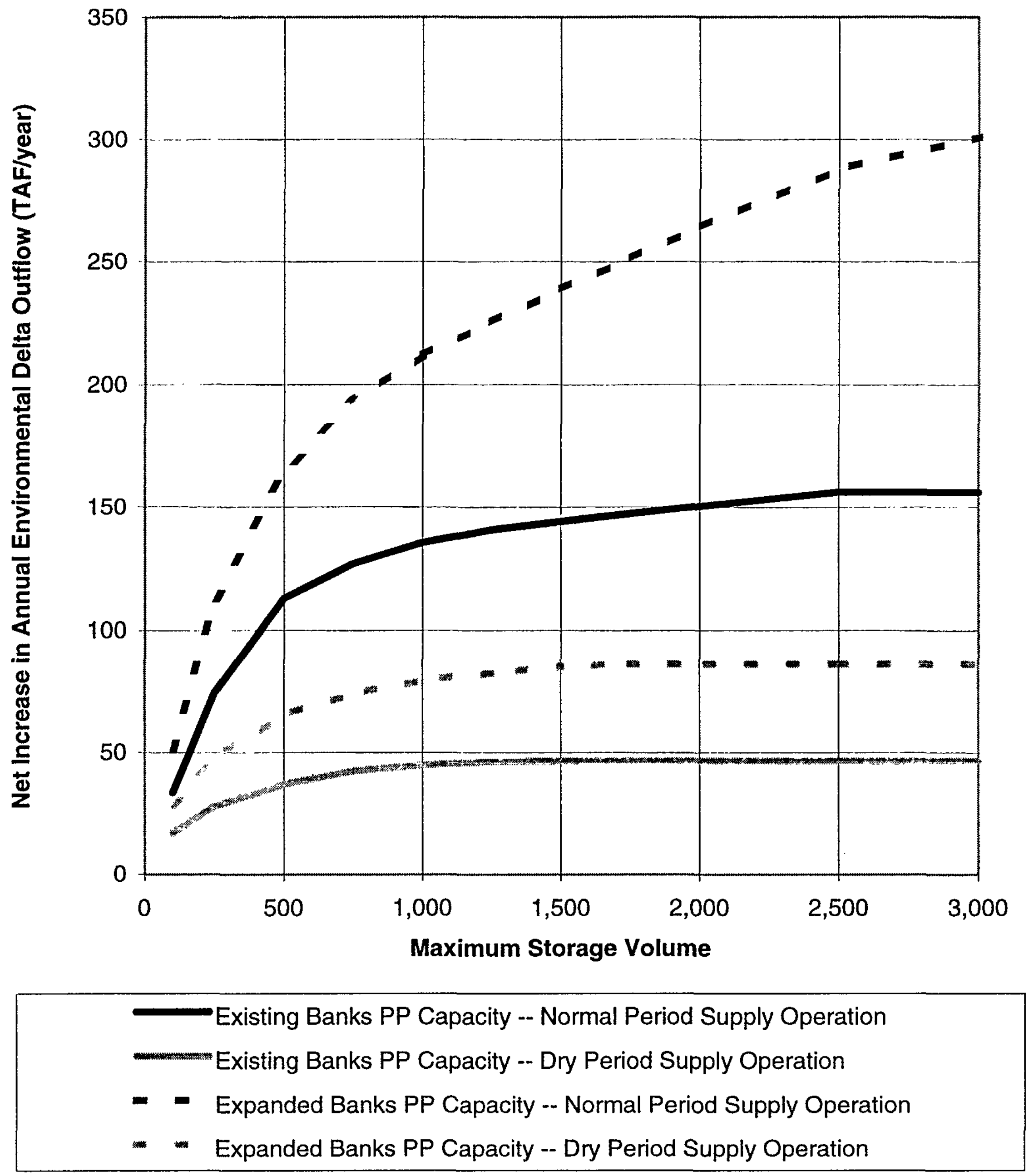
South of Delta Off-Aqueduct Storage
Minimum Annual Environmental Delta Outflow
versus Maximum Storage Volume



SE_RVSM.XLS: Min Annual Chart

Figure SE-43

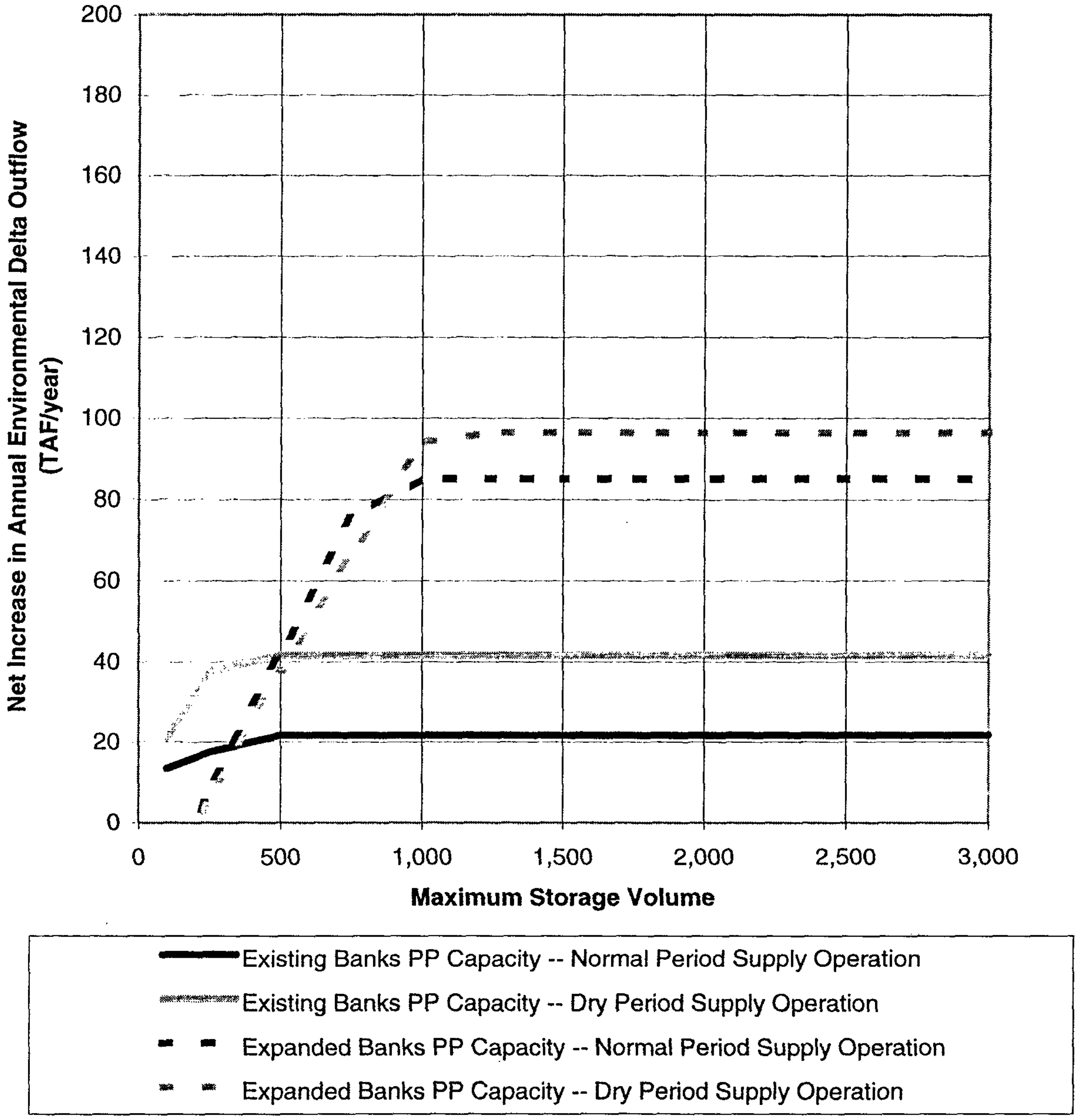
South of Delta Off-Aqueduct Storage Net increase in 71-Year Average Environmental Delta Outflow versus Maximum Storage Volume



SE_RVSM.XLS: Net 71-Yr Avg Chart

Figure SE-44

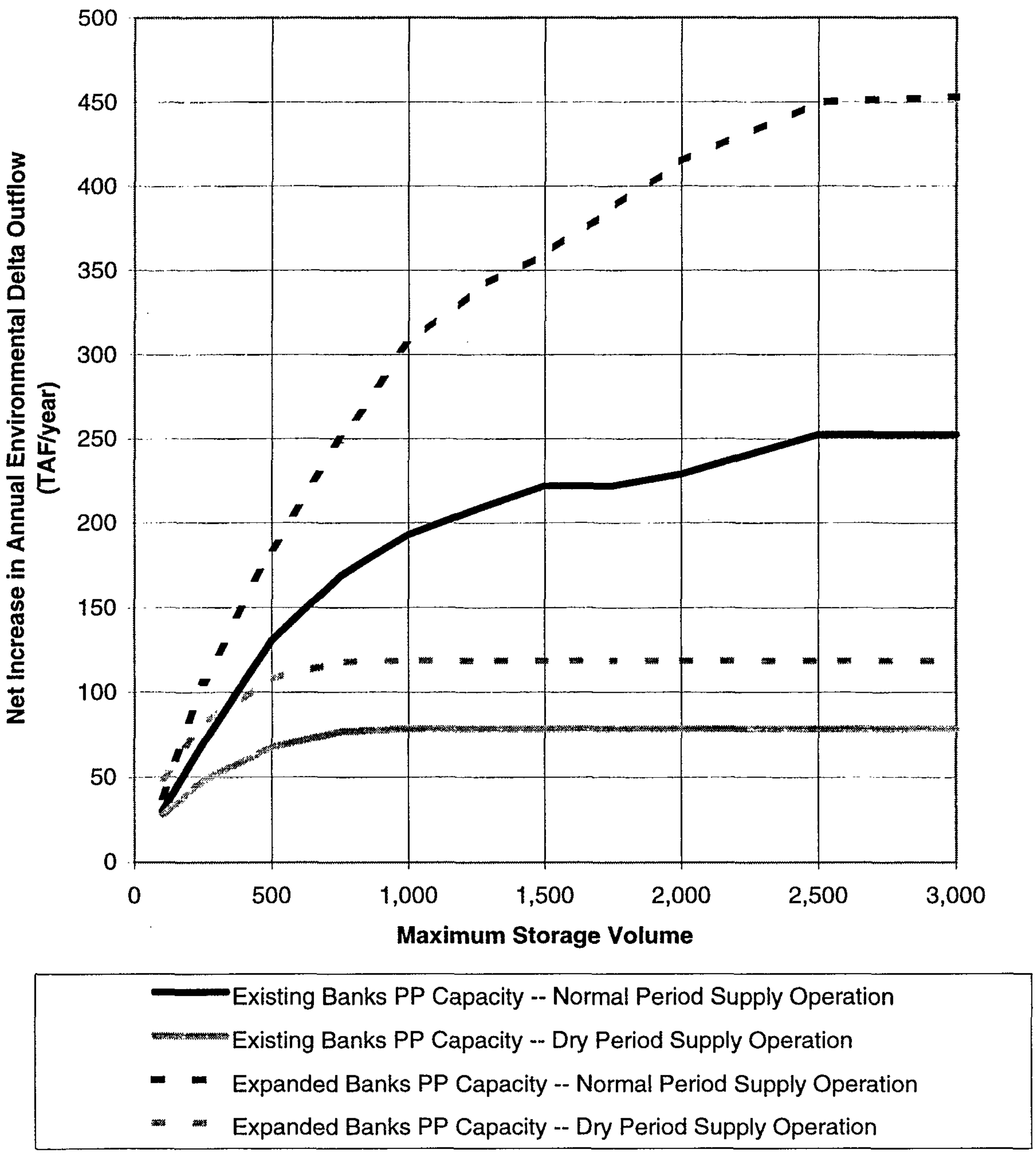
South of Delta Off-Aqueduct Storage
Net Increase in 1928-34 Dry Period Annual Average
Environmental Delta Outflow
versus Maximum Storage Volume



SE_RVSM.XLS: Net 1928-34 Chart

Figure SE-45

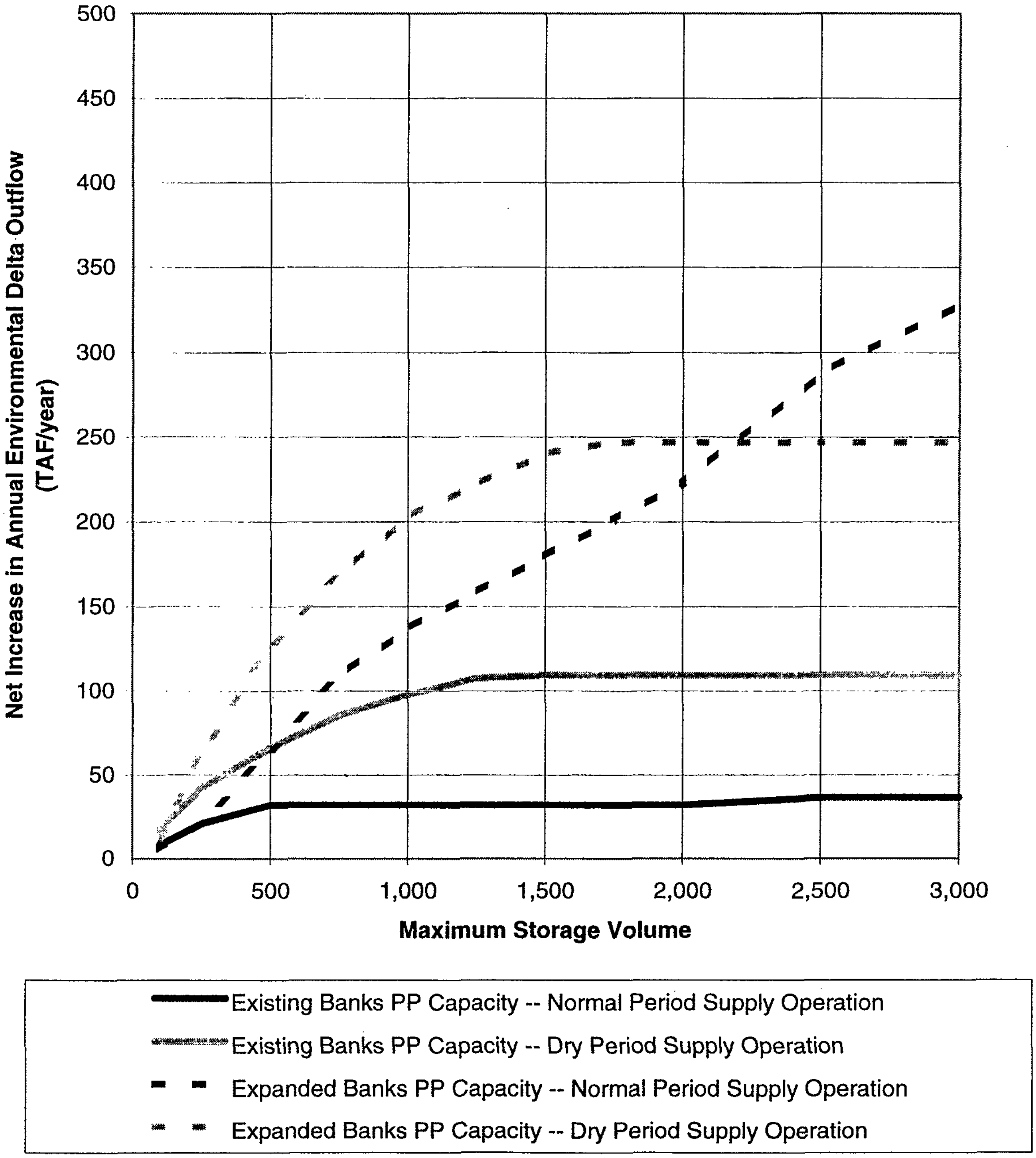
South of Delta Off-Aqueduct Storage
Net Increase in Dry Year Average Environmental Delta Outflow versus Maximum Storage Volume



SE_RVSM.XLS: Net Dry Years Chart

Figure SE-46

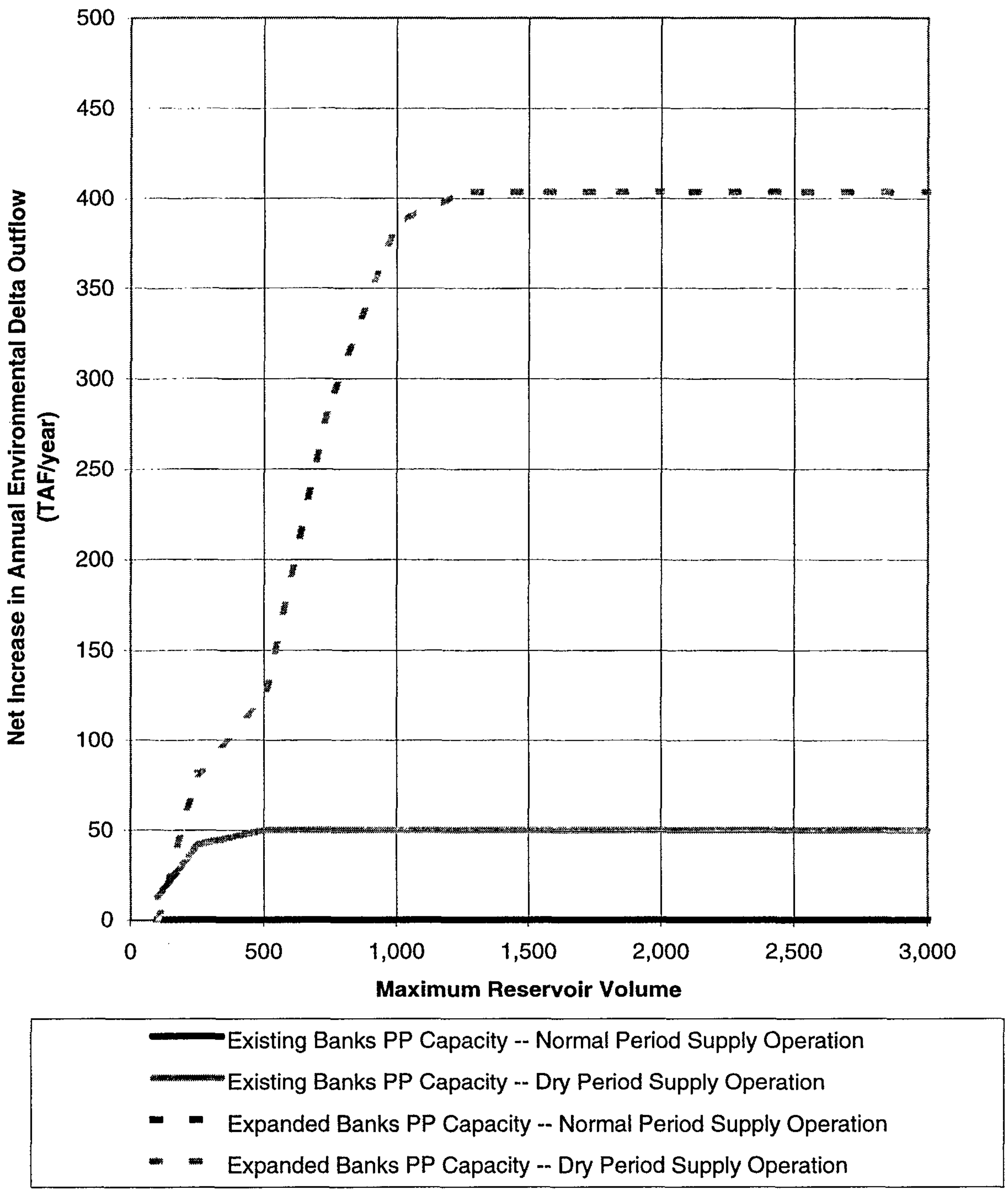
South of Delta Off-Aqueduct Storage Net Increase in Critical Year Average Environmental Delta Outflow versus Maximum Storage Volume



SE_RVSM.XLS: Net Crit Years Chart

Figure SE-47

South of Delta Off-Aqueduct Storage Net Increase in Minimum Annual Environmental Delta Outflow versus Maximum Storage Volume



SE_RVSM.XLS: Net Min Annual Chart

Initial Sensitivity Evaluation of Operational Parameters and Storage Capacities Using the CALFED Post-Processing Operations Model

South of Delta Off-Aqueduct Storage Facilities

AGRICULTURAL AND URBAN WATER SUPPLY EVALUATION

Introduction

Agricultural and urban water supply benefits from new south of Delta storage facilities would be achieved by diverting Delta water for storage during times of high flows and concurrent low-impacts to the Delta ecosystem. This stored water would be released for use during periods of need. The capacity of the new storage facility, rules governing diversions into storage, and operational goals (e.g. maximum normal period supply or maximum dry period supply) all affect the magnitude of potential agricultural and urban water supply benefits.

The CALFED spreadsheet operations model was used to evaluate effects of various operational rules and physical capacities of new south of Delta storage facilities on potential agricultural and urban water supply benefits. A sensitivity analysis was conducted by individually exercising the operational parameters through reasonable ranges with a set south of Delta maximum storage capacity of 2.0 maf and inflow/outflow conveyance capacities of 3,500 cfs, devoted exclusively to agricultural and urban water supply. Information from this phase of the evaluation was then used to develop four sets of parameters which collectively bracket the range of potential operations. These four sets of parameters define two operational goals implemented under two external conditions.

The first operational goal modeled is to maximize supplies over normal hyrdrologic periods. This goal is achieved by imposing no storage carryover requirement and releasing water from storage whenever unmet demand exists. A by-product of this type of operation is that supplies in storage are often depleted when entering critically dry periods. The second operational goal is to maximize supplies in the driest years of normal hydrologic sequences. This goal is achieved by imposing carryover requirements or limiting the amount of water delivered from storage in any given year. While this type of operation usually results in relatively larger quantities of water in storage for use during extended dry periods, overall long-term water deliveries are diminished.

The two external conditions considered in this evaluation address the capacity of Banks Pumping Plant, the State Water Project Delta pumping facility. Capacity of Banks Pumping Plant significantly affects storage operations under both the normal period supply and dry period supply operational goals considered in this evaluation. Under the first external condition, existing Banks Pumping Plant capacity is assumed. Under the

Table SA-1
Bracketing Operational Conditions

Condition	Description
A	Existing Banks PP Capacity -- Normal Period Supply Operation. This condition assumes that diversions to south of Delta storage are limited by existing Banks Pumping Plant capacity and that the storage facility is operated to provide maximum supplies over normal hydrologic periods.
B	Existing Banks PP Capacity -- Dry Period Supply Operation. This condition assumes that diversions to south of Delta storage are limited by existing Banks Pumping Plant capacity and that the storage facility is operated to provide maximum supplies in critically dry years.
C	Expanded Banks PP Capacity -- Normal Period Supply Operation. This condition assumes that diversions to south of Delta storage are supplemented by an increased Banks Pumping Plant capacity as proposed in the Department of Water Resources Interim South Delta Improvement Plan and that the storage facility is operated to provide maximum supplies over normal hydrologic periods.
D	Expanded Banks PP Capacity -- Dry Period Supply Operation. This condition assumes that diversions to south of Delta storage are supplemented by an increased Banks Pumping Plant capacity as proposed in the Department of Water Resources Interim South Delta Improvement Plan and that the storage facility is operated to provide maximum supplies in critically dry years.

Table SA-2
Statistical Measures of Agricultural and Urban Water Supply Benefits

Measure	Description
1	71-Year Average Annual Agricultural and Urban Water Supply Benefits. Annual average over the historical hydrologic sequence used in the model simulations.
2	1928-34 Critical Dry Period Average Annual Agricultural and Urban Water Supply Benefits. Annual average over the seven year critical dry period.
3	Average Dry Year Agricultural and Urban Water Supply Benefits. Annual average over the sixteen water years classified as dry years within the 71-year hydrologic sequence.
4	Average Critically Dry Year Agricultural and Urban Water Supply Benefits. Annual average over the eleven water years classified as critically dry years within the 71-year hydrologic sequence.
5	Minimum Annual Agricultural and Urban Water Supply Benefits. The minimum annual quantity that occurs over the 71-year hydrologic sequence.

second external condition, an expanded Banks Pumping Plant capacity as proposed in the Department of Water Resources South Delta Improvements Plan is assumed. The four operation conditions defined by the two operational goals under these two external conditions are described in Table SA-1.

Once developed, parameters sets for each of the four operation conditions were input to the CALFED spreadsheet operations model. Potential agricultural and urban water supply benefits were evaluated for maximum storage capacities ranging from 100 taf to 3.0 maf. In this evaluation, south of Delta SWP and CVP demands were used as a surrogate for agricultural and urban water supply demands. In actual practice, agricultural and urban water supply benefits from south of Delta storage might be designated to a subset of SWP and CVP users, other south of Delta agricultural and urban users, or upstream of Delta users through a water exchange program. Five statistical measures of agricultural and urban water supply benefits are included in this analysis, as described in Table SA-2.

Agricultural and urban water supply benefits, as described by these five measures, were estimated for each of the four sets of operation conditions over the range of maximum storage volumes. While this information should not be considered definitive, this evaluation illustrates the potential for agricultural and urban benefits from south of Delta storage facilities and the effects of various operation conditions. The information developed in this evaluation may be used to provide an initial refinement of the range of storage volumes of potential south of Delta storage facilities which should be considered in future studies.

Summary

This evaluation provides initial quantitative information on agricultural and urban water supply benefits that might be provided by new south of Delta storage facilities. Additional information on water quality benefits, interaction with environmental water supply opportunities, interactions with other potential new storage and conveyance facilities, costs of new storage facilities, and environmental acceptability of new storage facilities must all be considered in a further refinement of agricultural and urban water storage facilities.

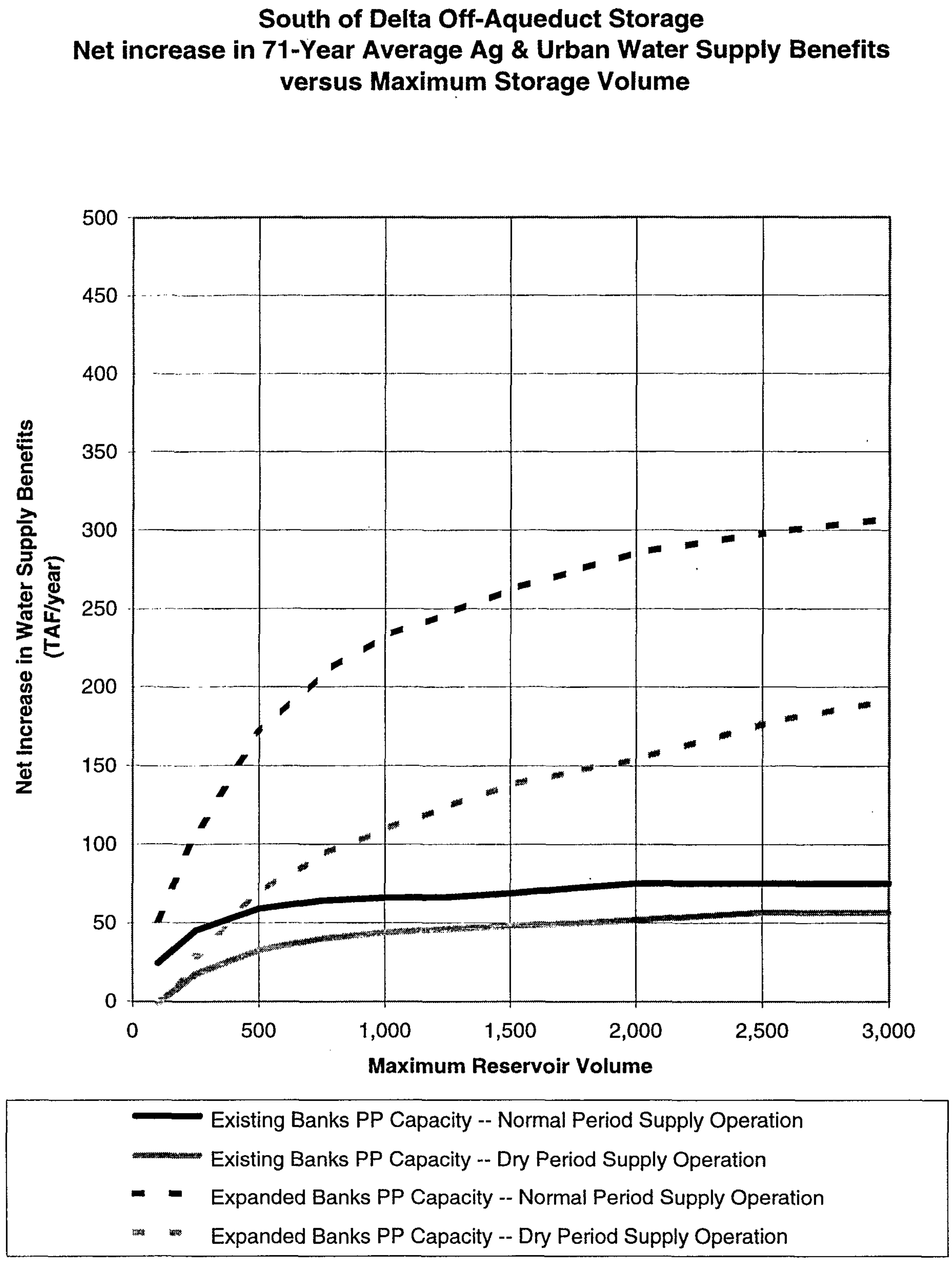
Summary results of this initial evaluation are presented in Figures SA-1 and SA-2. These charts depict net increases in 71-Year Average Annual Agricultural and Urban Water Supply Benefits and Minimum Annual Agricultural and Urban Water Supply Benefits, respectively, under the four operation conditions described in Table SA-1 for storage volumes ranging from 0 to 3.0 maf. The charts allow comparison of the range of potential benefits under various Banks Pumping Plant capacities, operational goals, and storage capacities.

As evidenced by the ranges between the curves of Figures SA-1 and SA-2, this initial evaluation demonstrates the importance of operating assumptions on the outcome of water supply evaluations. As expected, normal period supply operations maximize average annual water supplies, but provide little benefit during extended dry periods. On the other hand, dry period supply operations allow for carrying water in storage through extended dry periods, at a very high cost in average annual yield. This is illustrated by comparing the curves representing Existing Banks Pumping Plant Capacity -- Dry Period Supply Operation in Figures SA-1 and SA-2. As shown in Figure SA-1, at a storage volume of 1.5 maf the Existing Banks Pumping Plant Capacity -- Dry Period Supply Operation reaches an net increase of about 50 taf in 71-Year Average Annual Agricultural and Urban Water Supply Benefits. Figure SA-2 shows that Minimum Annual Agricultural and Urban Water Supply Benefits reach a net benefit of about 250 taf at this same 1.5 maf capacity. However, with the same 1.5 maf storage capacity, the Existing Banks Pumping Plant Capacity -- Normal Period Supply Operation yields about 70 taf net increase for the 71-Year Average Annual Agricultural and Urban Water Supply Benefits compared to 0 taf net increase for the Minimum Annual Agricultural and Urban Water Supply Benefits.

This initial evaluation indicates that with existing Banks Pumping Plant capacity only minor agricultural and urban water supply benefits might be derived from new south of Delta storage facilities. The net increase in 71-Year Average Annual Agricultural and Urban Water Supply Benefits with a 1.5 maf maximum storage capacity is 70 taf. Only minor increases in 71-Year Average Annual Agricultural and Urban Water Supply Benefits are possible with larger maximum storage capacities. Potential net increase in Minimum Annual Agricultural and Urban Water Supply Benefits is about 250 taf and is achieved with this same maximum storage capacity of 1.5 maf.

More significant agricultural and urban water supply benefits might be derived from new south of Delta storage facilities with an expanded Banks Pumping Plant capacity. A net increase in 71-Year Average Annual Agricultural and Urban Water Supply Benefits of about 290 taf is possible with a storage capacity of 2.0 maf. Minor additional 71-Year Average Annual Delta Outflow could be achieved with additional storage capacity, with a net benefit of 310 taf with a 3.0 maf storage capacity. Potential net benefit in Minimum Annual Agricultural and Urban Water Supply Benefits could exceed 420 taf with a maximum storage capacity of 2.0 maf.

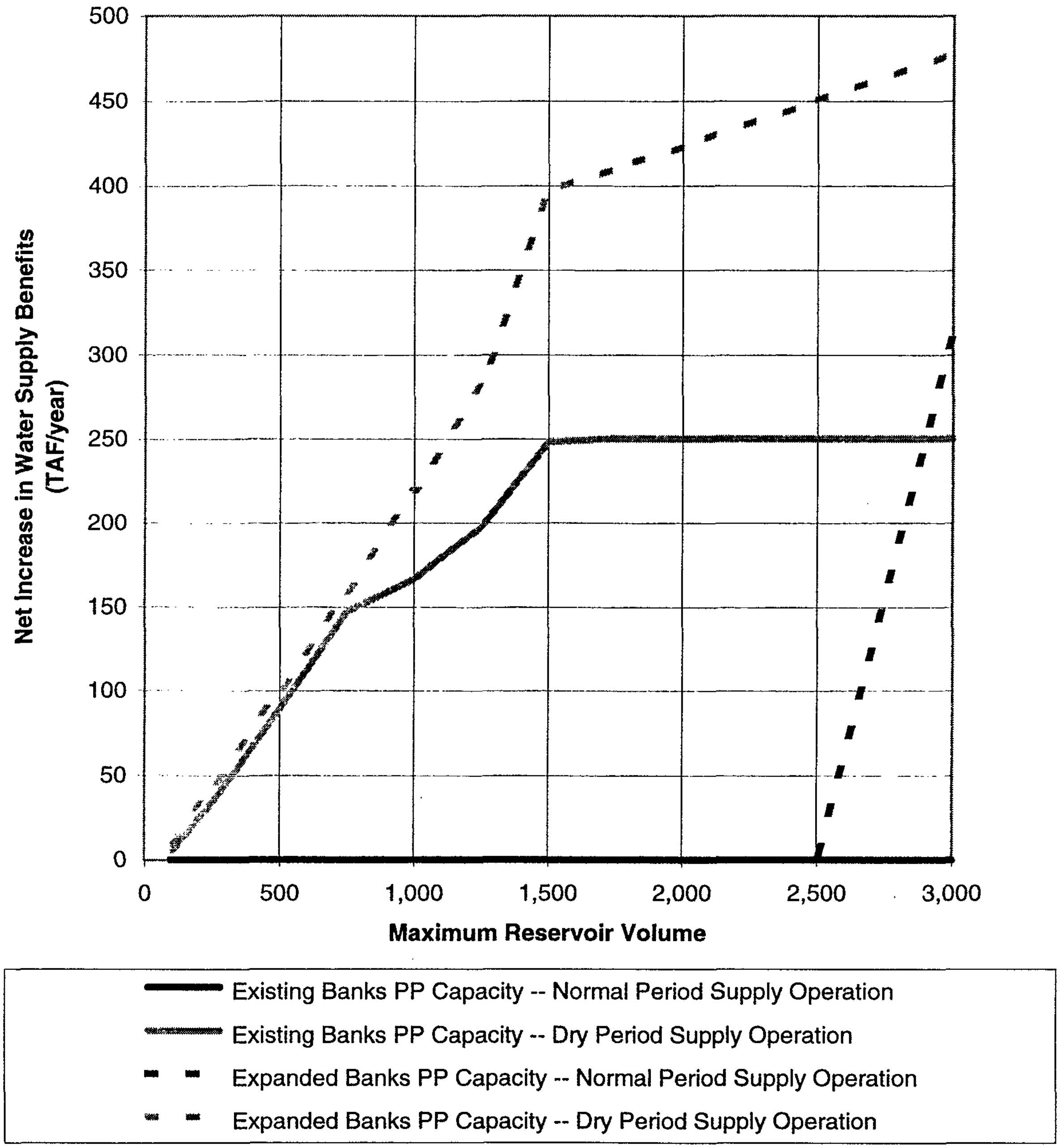
Figure SA-1



SA_RVSM.XLS: Net 71-Yr Avg Chart

Figure SA-2

South of Delta Off-Aqueduct Storage
Net Increase in Minimum Annual Ag & Urban Water Supply Benefits versus Maximum Storage Volume



SA_RVSM.XLS: Net Min Annual Chart

Agricultural and Urban Water Supply Benefits versus Storage Carryover Factor

Background

The storage carryover factor is an operational parameter designed to provide a means of reserving water supplies for use throughout extended dry periods. In practice, complex reservoir storage carryover rules may be devised to take into account runoff forecasting, variable demand, current storage volume, and other criteria. In this model, a simple storage carryover function has been included which allows the user to set a fraction of end-of-September storage from the previous water year that will be required to remain in storage at the end of the current water year. For example, if 100 taf are in storage at the end of September of the current year, with a storage carryover factor of 70 percent, the storage facility must maintain at least 70 taf by the end of September of the following year. While implementing conservative carryover rules in reservoir operations will increase available supplies during dry periods, total deliveries over normal hydrologic periods will be reduced in comparison to more aggressive reservoir operations.

Model Runs

Storage carryover factors ranging from 0 to 70 percent were varied in a set of model runs to evaluate effects on water supply benefits 1) with and without expanded Banks Pumping Plant capacity and 2) with varied unmet demand targets. These model runs are described in Table SA-3 and summary results are displayed in Table SA-4. For comparability, all results are measured using total south of Delta SWP and CVP water supply deliveries.

Evaluation -- Sensitivity Analysis

Varying the storage carryover factor results in negligible effects for all runs with existing Banks Pumping Plant capacity. Less than 1-percent differences are seen in 71-Year Average Annual Agricultural and Urban Water Supply Benefits and less than 3-percent differences are seen in Minimum Annual Agricultural and Urban Water Supply Benefits throughout the range of storage carryover factors evaluated. Charts displaying the five measures of Agricultural and Urban Water Supply Benefits described in Table SA-2 are plotted versus storage carryover factor for the existing Banks Pumping Plant capacity condition are shown in Figures SA-3 and SA-4.

More substantial effects occur in runs with expanded Banks Pumping Plant capacity. While less than 1-percent decreases in 71-Year Average Annual Agricultural and Urban Water Supply Benefits occur while varying storage carryover factors between 0 percent and 70 percent, Minimum Annual Agricultural and Urban Water Supply Benefits increase up to 11 percent. Plots of the five measures of Agricultural and Urban Water Supply Benefits versus storage carryover factor for the expanded Banks Pumping Plant capacity condition are shown in Figures SA-5 and SA-6.

The storage carryover factor has a minor effect in reserving water supplies through extended dry periods, but corresponding losses in normal period supply are negligible. The storage carryover factor has a larger relative effect with larger unmet target demands. Storage carryover factors of 50 to 60 percent appear to be the most effective.

Table SA-3

South of Delta Off-Aqueduct Storage
Model Runs for Evaluation of Storage Carryover Factor

Run Results Workbook	Evaluation Workbook	Model Run Identifiers	Storage Carryover Factor	Common Assumptions
OUT_SO1.XLS	SA_CO1.XLS	SA001	0%	2.0 maf Maximum Storage Volume
		SA002	10%	3,500 cfs Inflow/Outflow Capacity
		SA003	20%	Existing Banks PP Capacity
		SA004	30%	Unmet Demand Target = SWP & CVP
		SA005	40%	
		SA006	50%	
		SA007	60%	
		SA008	70%	
OUT_SO1.XLS	SA_CO2.XLS	SA009	0%	2.0 maf Maximum Storage Volume
		SA010	10%	3,500 cfs Inflow/Outflow Capacity
		SA011	20%	Existing Banks PP Capacity
		SA012	30%	Unmet Demand Target = SWP
		SA013	40%	
		SA014	50%	
		SA015	60%	
		SA016	70%	
OUT_SO1.XLS	SA_CO3.XLS	SA017	0%	2.0 maf Maximum Storage Volume
		SA018	10%	3,500 cfs Inflow/Outflow Capacity
		SA019	20%	SDI Banks PP Capacity
		SA020	30%	Unmet Demand Target = SWP & CVP
		SA021	40%	
		SA022	50%	
		SA023	60%	
		SA024	70%	
OUT_SO1.XLS	SA_CO4.XLS	SA025	0%	2.0 maf Maximum Storage Volume
		SA026	10%	3,500 cfs Inflow/Outflow Capacity
		SA027	20%	SDI Banks PP Capacity
		SA028	30%	Unmet Demand Target = SWP
		SA029	40%	
		SA030	50%	
		SA031	60%	
		SA032	70%	

Table SA-4

South of Delta Off-Aqueduct Storage
Ag & Urban Water Supply Benefits vs. Storage Carryover Factor
Under Various Operational Conditions[1]

(Values in thousands of acre-feet)

Run Identifiers:	SA001	SA002	SA003	SA004	SA005	SA006	SA007	SA008	Minimum Value	Maximum Value	Percent Difference
Storage Carryover Factor	0%	10%	20%	30%	40%	50%	60%	70%			
71-Year Average	5,996	5,996	5,996	5,995	5,994	5,993	5,991	5,988	5,988	5,996	0.1%
1928-34 Dry Period Average	3,919	3,919	3,919	3,919	3,919	3,919	3,919	3,919	3,919	3,919	0.0%
Dry Year Average	5,510	5,505	5,500	5,496	5,492	5,488	5,483	5,475	5,475	5,510	0.6%
Critically Dry Year Average	3,421	3,423	3,425	3,427	3,431	3,436	3,442	3,448	3,421	3,448	0.8%
Minimum Annual	2,206	2,208	2,211	2,216	2,221	2,227	2,232	2,236	2,206	2,236	1.4%

Run Identifiers:	SA009	SA010	SA011	SA012	SA013	SA014	SA015	SA016	Minimum Value	Maximum Value	Percent Difference
Storage Carryover Factor	0%	10%	20%	30%	40%	50%	60%	70%			
71-Year Average	5,979	5,978	5,978	5,977	5,975	5,973	5,970	5,965	5,965	5,979	0.2%
1928-34 Dry Period Average	3,944	3,944	3,943	3,943	3,942	3,941	3,939	3,940	3,939	3,944	0.1%
Dry Year Average	5,548	5,543	5,538	5,532	5,527	5,518	5,508	5,499	5,499	5,548	0.9%
Critically Dry Year Average	3,548	3,545	3,541	3,537	3,530	3,526	3,520	3,513	3,513	3,548	1.0%
Minimum Annual	2,490	2,461	2,432	2,422	2,450	2,457	2,445	2,422	2,422	2,490	2.8%

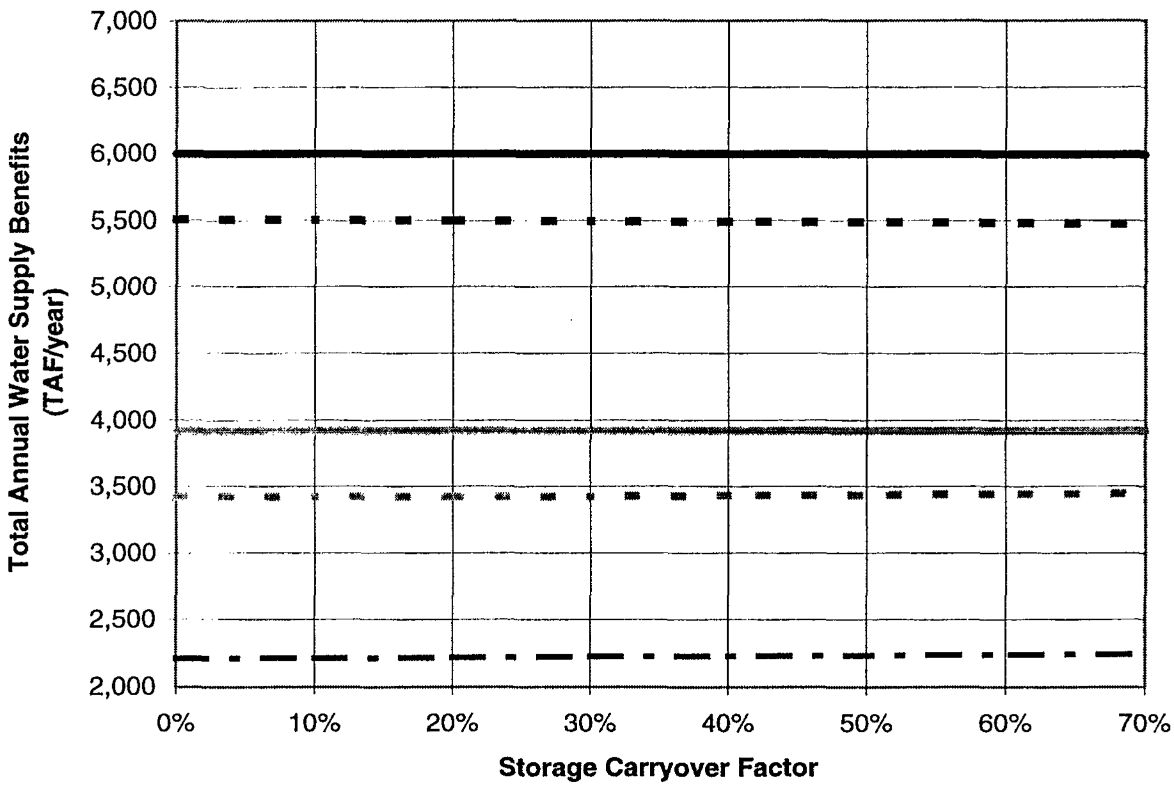
Run Identifiers:	SA017	SA018	SA019	SA020	SA021	SA022	SA023	SA024	Minimum Value	Maximum Value	Percent Difference
Storage Carryover Factor	0%	10%	20%	30%	40%	50%	60%	70%			
71-Year Average	6,455	6,454	6,453	6,452	6,450	6,447	6,441	6,432	6,432	6,455	0.3%
1928-34 Dry Period Average	4,118	4,118	4,119	4,119	4,119	4,120	4,120	4,121	4,118	4,121	0.1%
Dry Year Average	6,034	6,025	6,008	5,992	5,972	5,949	5,929	5,910	5,910	6,034	2.1%
Critically Dry Year Average	3,571	3,572	3,573	3,573	3,573	3,574	3,575	3,575	3,571	3,575	0.1%
Minimum Annual	2,184	2,258	2,316	2,360	2,392	2,410	2,421	2,416	2,184	2,421	10.9%

Run Identifiers:	SA025	SA026	SA027	SA028	SA029	SA030	SA031	SA032	Minimum Value	Maximum Value	Percent Difference
Storage Carryover Factor	0%	10%	20%	30%	40%	50%	60%	70%			
71-Year Average	6,335	6,334	6,333	6,331	6,328	6,323	6,317	6,307	6,307	6,335	0.4%
1928-34 Dry Period Average	4,184	4,183	4,182	4,181	4,180	4,179	4,178	4,175	4,175	4,184	0.2%
Dry Year Average	5,992	6,004	6,013	6,019	6,016	5,995	5,967	5,933	5,933	6,019	1.5%
Critically Dry Year Average	3,849	3,818	3,789	3,763	3,740	3,716	3,694	3,667	3,667	3,849	4.9%
Minimum Annual	2,547	2,547	2,552	2,564	2,583	2,607	2,631	2,570	2,547	2,631	3.3%

[1]See Table SA-3 for description of operational conditions.

Figure SA-3

South of Delta Off-Aqueduct Storage
Ag & Urban Water Supply Benefits versus Storage Carryover Factor



Assumptions

Storage Volume = 2.0 MAF
Conveyance Capacity = 3,500 cfs
Existing Banks PP Capacity
A&U Storage Carryover Factor = 0%
Unmet Demand Target = SWP & CVP

71-Year Average
1928-34 Dry Period Average
Dry Year Average
Critically Dry Year Average
Minimum Annual

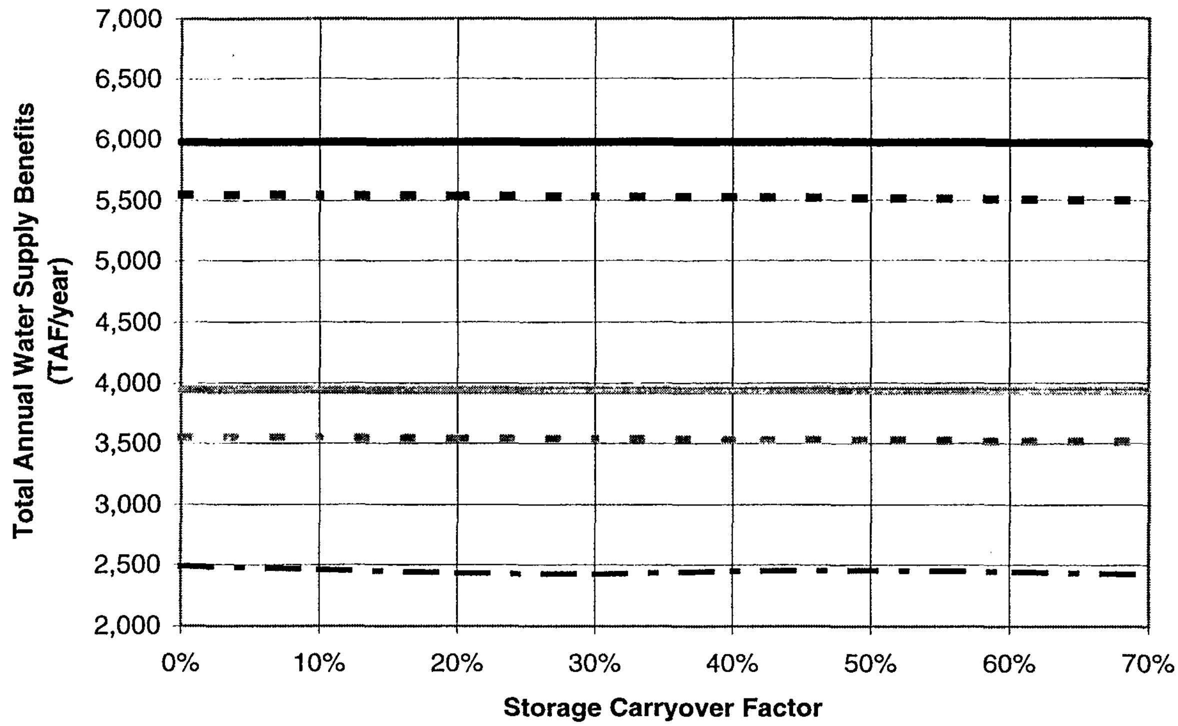
Total Water Supply Benefits (TAF/yr)

Storage Carryover Factor:	0%	70%
71-Year Average:	5,996	5,988
1928-34 Dry Period Average:	3,919	3,919
Average of all Dry Years:	5,510	5,475
Average of all Crit. Dry Years:	3,421	3,448
Minimum Annual:	2,206	2,236

SA_CO1.XLS: XY-Tot Chart 1

Figure SA-4

South of Delta Off-Aqueduct Storage
Ag & Urban Water Supply Benefits versus Storage Carryover Factor



Assumptions

Storage Volume = 2.0 MAF
Conveyance Capacity = 3,500 cfs
Existing Banks PP Capacity
A&U Storage Carryover Factor = 0%
Unmet Demand Target = SWP

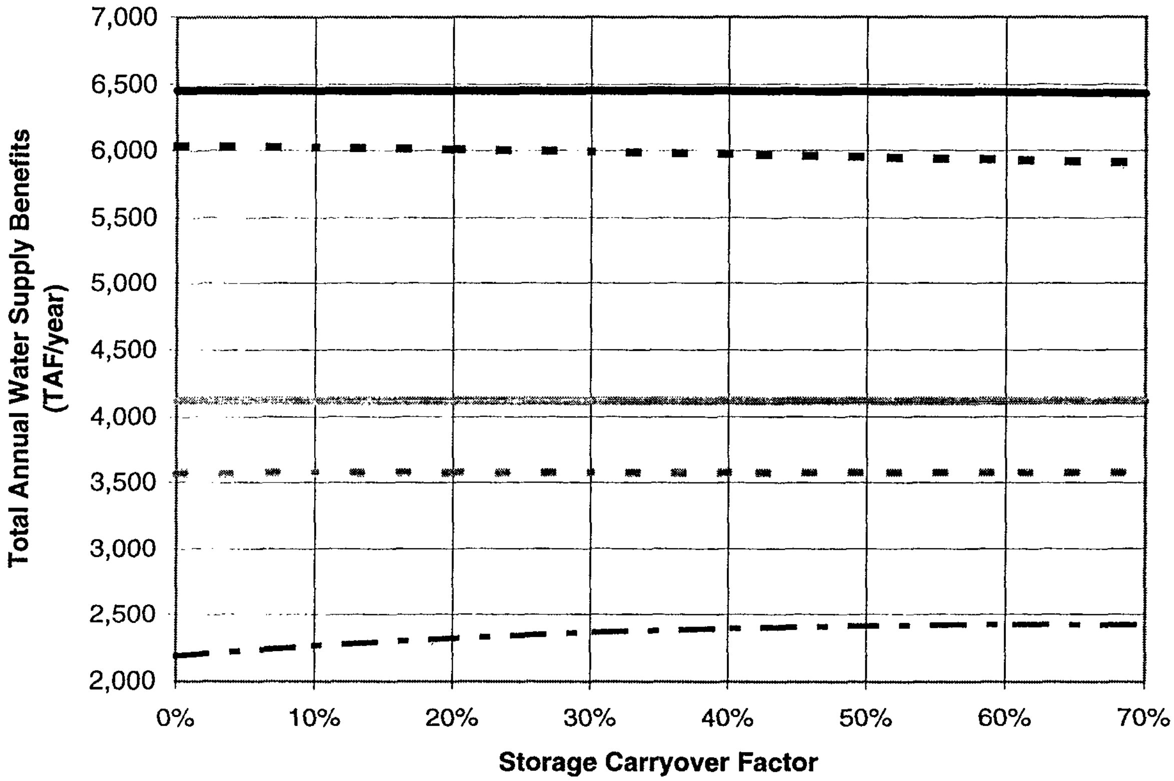
Total Water Supply Benefits (TAF/yr)

Storage Carryover Factor:	0%	70%
71-Year Average:	5,979	5,965
1928-34 Dry Period Average:	3,944	3,940
Average of all Dry Years:	5,548	5,499
Average of all Crit. Dry Years:	3,548	3,513
Minimum Annual:	2,490	2,422

SA_CO2.XLS: XY-Tot Chart 1

Figure SA-5

South of Delta Off-Aqueduct Storage
Ag & Urban Water Supply Benefits versus Storage Carryover Factor



Assumptions

Storage Volume = 2.0 MAF
Conveyance Capacity = 3,500 cfs
SDI Banks PP Capacity
A&U Storage Carryover Factor = 0%
Unmet Demand Target = SWP & CVP

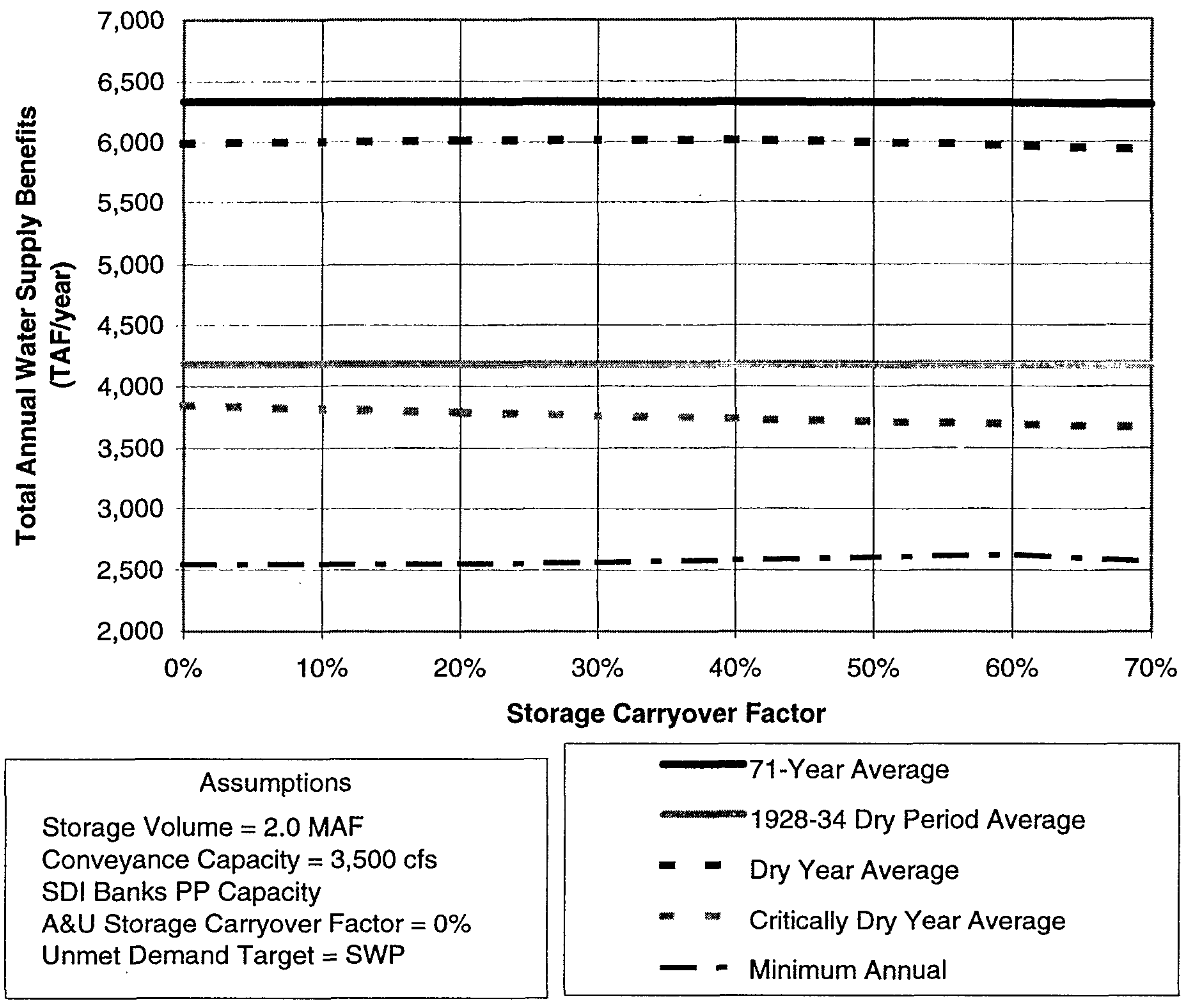
Total Water Supply Benefits (TAF/yr)

Storage Carryover Factor:	0%	70%
71-Year Average:	6,455	6,432
1928-34 Dry Period Average:	4,118	4,121
Average of all Dry Years:	6,034	5,910
Average of all Crit. Dry Years:	3,571	3,575
Minimum Annual:	2,184	2,416

SA_CO3.XLS: XY-Tot Chart 1

Figure SA-6

South of Delta Off-Aqueduct Storage
Ag & Urban Water Supply Benefits versus Storage Carryover Factor



Assumptions

Storage Volume = 2.0 MAF
Conveyance Capacity = 3,500 cfs
SDI Banks PP Capacity
A&U Storage Carryover Factor = 0%
Unmet Demand Target = SWP

Total Water Supply Benefits (TAF/yr)

Storage Carryover Factor:	0%	70%
71-Year Average:	6,335	6,307
1928-34 Dry Period Average:	4,184	4,175
Average of all Dry Years:	5,992	5,933
Average of all Crit. Dry Years:	3,849	3,667
Minimum Annual:	2,547	2,570

SA_CO4.XLS: XY-Tot Chart 1

Water Supply Benefits versus Unmet Demand Target

Background

Unmet south of Delta SWP and CVP demands are used in this evaluation as a surrogate for agricultural and urban water demands. Higher demand levels deplete reservoir storage more often, resulting in higher average deliveries over normal hydrologic periods but reduced deliveries during extended dry periods.

Model Runs

Unmet demand targets ranging from SWP-only unmet demand to combined SWP and CVP unmet demand were varied in a set of model runs to evaluate effects on water supply benefits 1) with and without expanded Banks Pumping Plant capacity and 2) varied storage carryover factors. These model runs are described in Table SA-5 and summary results are displayed in Table SA-6. For comparability, all results are measured using total south of Delta SWP and CVP water supply deliveries.

Evaluation-- Sensitivity Analysis

Moderate effects of varying unmet demand targets are observed in runs with existing Banks Pumping Plant capacity. Less than a 1-percent increase in 71-Year Average Annual Agricultural and Urban Water Supply Benefits is observed while up to 13-percent decreases occur in Minimum Annual Agricultural and Urban Water Supply Benefits as the unmet demand target is increased from unmet SWP demand to combined unmet SWP and CVP demand. Minor effects are seen in dry and critical year averages, all within a 4-percent range. Bar charts of the five measures of Agricultural and Urban Water Supply Benefits for various unmet demand targets for the existing Banks Pumping Plant capacity condition are shown in Figures SA-7 through SA-10.

Moderate effects are also observed in runs with expanded Banks Pumping Plant capacity. Increases of up to 2 percent occur in 71-Year Averages Annual Agricultural and Urban Water Supply Benefits. Increases of up to 17 percent in Minimum Annual Agricultural and Urban Water Supply Benefits result as the operating target is reduced from SWP and CVP unmet demand to SWP-only unmet demand. with storage carryover factor set at 0 percent. Plots of the five measures of Agricultural and Urban Water Supply Benefits versus unmet demand target for the expanded Banks Pumping Plant condition are shown in Figures SA-11 through SA-14.

This operational parameter has a significant effect on Minimum Annual Agricultural and Urban Water Supply Benefits, particularly with expanded Banks Pumping Plant capacity in place. Corresponding effects on 71-Year Average Annual Agricultural and Urban Water Supply Benefits are minor. The largest effects occur with storage carryover factor set at 0 percent.

Table SA-5

South of Delta Off-Aqueduct Storage
Model Runs for Evaluation of Unmet Demand Target

Run Results Workbook	Evaluation Workbook	Model Run Identifiers	Unmet Demand Target (cfs)	Common Assumptions
OUT_SO2.XLS	SA_DE1.XLS	SA033 SA034 SA035	SWP CVP SWP & CVP	2.0 maf Maximum Storage Volume 3,500 cfs Inflow/Outflow Capacity Existing Banks PP Capacity Storage Carryover Factor = 0%
OUT_SO2.XLS	SA_DE2.XLS	SA036 SA037 SA038	SWP CVP SWP & CVP	2.0 maf Maximum Storage Volume 3,500 cfs Inflow/Outflow Capacity Existing Banks PP Capacity Storage Carryover Factor = 30%
OUT_SO2.XLS	SA_DE3.XLS	SA039 SA040 SA041	SWP CVP SWP & CVP	2.0 maf Maximum Storage Volume 3,500 cfs Inflow/Outflow Capacity Existing Banks PP Capacity Storage Carryover Factor = 50%
OUT_SO2.XLS	SA_DE4.XLS	SA042 SA043 SA044	SWP CVP SWP & CVP	2.0 maf Maximum Storage Volume 3,500 cfs Inflow/Outflow Capacity Existing Banks PP Capacity Storage Carryover Factor = 70%
OUT_SO2.XLS	SA_DE5.XLS	SA045 SA046 SA047	SWP CVP SWP & CVP	2.0 maf Maximum Storage Volume 3,500 cfs Inflow/Outflow Capacity SDI Banks PP Capacity Storage Carryover Factor = 0%
OUT_SO2.XLS	SA_DE6.XLS	SA048 SA049 SA050	SWP CVP SWP & CVP	2.0 maf Maximum Storage Volume 3,500 cfs Inflow/Outflow Capacity SDI Banks PP Capacity
OUT_SO2.XLS	SA_DE7.XLS	SA051 SA052 SA053	SWP CVP SWP & CVP	2.0 maf Maximum Storage Volume 3,500 cfs Inflow/Outflow Capacity SDI Banks PP Capacity Storage Carryover Factor = 50%
OUT_SO2.XLS	SA_DE8.XLS	SA054 SA055 SA056	SWP CVP SWP & CVP	2.0 maf Maximum Storage Volume 3,500 cfs Inflow/Outflow Capacity SDI Banks PP Capacity Storage Carryover Factor = 70%

Table SA-6

South of Delta Off-Aqueduct Storage
Total Ag & Urban Water Supply Benefits vs. Unmet Demand Target
Under Various Operational Conditions[1]
(Values in thousands of acre-feet)

Run Identifiers:	SA033	SA034	SA035	Minimum Value	Maximum Value	Percent Difference
Unmet Demand Target:	SWP	CVP	SWP & CVP			
71-Year Average	5,979	5,991	5,996	5,979	5,996	0.3%
1928-34 Dry Period Average	3,944	3,919	3,919	3,919	3,944	0.6%
Dry Year Average	5,548	5,503	5,510	5,503	5,548	0.8%
Critically Dry Year Average	3,548	3,433	3,421	3,421	3,548	3.7%
Minimum Annual	2,490	2,206	2,206	2,206	2,490	12.9%

Run Identifiers:	SA036	SA037	SA038	Minimum Value	Maximum Value	Percent Difference
Unmet Demand Target:	SWP	CVP	SWP & CVP			
71-Year Average	5,977	5,989	5,995	5,977	5,995	0.3%
1928-34 Dry Period Average	3,943	3,919	3,919	3,919	3,943	0.6%
Dry Year Average	5,532	5,505	5,496	5,496	5,532	0.7%
Critically Dry Year Average	3,537	3,435	3,427	3,427	3,537	3.2%
Minimum Annual	2,422	2,233	2,216	2,216	2,422	9.3%

Run Identifiers:	SA039	SA040	SA041	Minimum Value	Maximum Value	Percent Difference
Unmet Demand Target:	SWP	CVP	SWP & CVP			
71-Year Average	5,973	5,987	5,993	5,973	5,993	0.3%
1928-34 Dry Period Average	3,941	3,919	3,919	3,919	3,941	0.6%
Dry Year Average	5,518	5,496	5,488	5,488	5,518	0.5%
Critically Dry Year Average	3,526	3,441	3,436	3,436	3,526	2.6%
Minimum Annual	2,457	2,243	2,227	2,227	2,457	10.3%

Run Identifiers:	SA042	SA043	SA044	Minimum Value	Maximum Value	Percent Difference
Unmet Demand Target:	SWP	CVP	SWP & CVP			
71-Year Average	5,965	5,980	5,988	5,965	5,988	0.4%
1928-34 Dry Period Average	3,940	3,919	3,919	3,919	3,940	0.5%
Dry Year Average	5,499	5,481	5,475	5,475	5,499	0.4%
Critically Dry Year Average	3,513	3,454	3,448	3,448	3,513	1.9%
Minimum Annual	2,422	2,252	2,236	2,236	2,422	8.3%

Run Identifiers:	SA045	SA046	SA047	Minimum Value	Maximum Value	Percent Difference
Unmet Demand Target:	SWP	CVP	SWP & CVP			
71-Year Average	6,335	6,410	6,455	6,335	6,455	1.9%
1928-34 Dry Period Average	4,184	4,124	4,118	4,118	4,184	1.6%
Dry Year Average	5,992	5,957	6,034	5,957	6,034	1.3%
Critically Dry Year Average	3,849	3,631	3,571	3,571	3,849	7.8%
Minimum Annual	2,547	2,547	2,184	2,184	2,547	16.6%

Run Identifiers:	SA048	SA049	SA050	Minimum Value	Maximum Value	Percent Difference
Unmet Demand Target:	SWP	CVP	SWP & CVP			
71-Year Average	6,331	6,407	6,452	6,331	6,452	1.9%
1928-34 Dry Period Average	4,181	4,127	4,119	4,119	4,181	1.5%
Dry Year Average	6,019	5,958	5,992	5,958	6,019	1.0%
Critically Dry Year Average	3,763	3,624	3,573	3,573	3,763	5.3%
Minimum Annual	2,564	2,547	2,360	2,360	2,564	8.7%

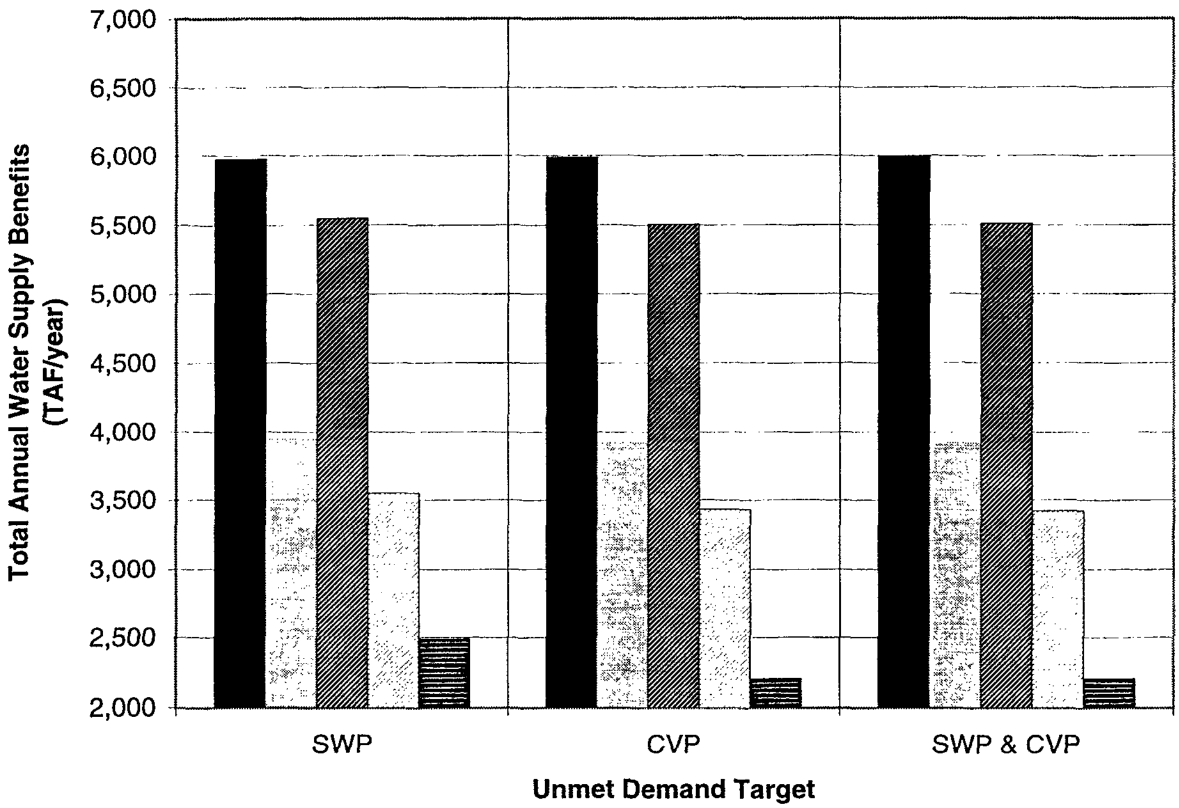
Run Identifiers:	SA051	SA052	SA053	Minimum Value	Maximum Value	Percent Difference
Unmet Demand Target:	SWP	CVP	SWP & CVP			
71-Year Average	6,323	6,403	6,447	6,323	6,447	2.0%
1928-34 Dry Period Average	4,179	4,129	4,120	4,120	4,179	1.4%
Dry Year Average	5,995	5,954	5,949	5,949	5,995	0.8%
Critically Dry Year Average	3,716	3,615	3,574	3,574	3,716	4.0%
Minimum Annual	2,607	2,554	2,410	2,410	2,607	8.2%

Run Identifiers:	SA054	SA055	SA056	Minimum Value	Maximum Value	Percent Difference
Unmet Demand Target:	SWP	CVP	SWP & CVP			
71-Year Average	6,307	6,389	6,432	6,307	6,432	2.0%
1928-34 Dry Period Average	4,175	4,131	4,121	4,121	4,175	1.3%
Dry Year Average	5,933	5,908	5,910	5,908	5,933	0.4%
Critically Dry Year Average	3,667	3,595	3,575	3,575	3,667	2.6%
Minimum Annual	2,570	2,495	2,416	2,416	2,570	6.4%

[1]See Table SE-5 for description of operational conditions.

Figure SA-7

South of Delta Off-Aqueduct Storage
Ag & Urban Water Supply Benefits versus Unmet Demand Target



Assumptions
Storage Volume = 2.0 MAF
Conveyance Capacity = 3,500 cfs
Existing Banks PP Capacity
A&U Storage Carryover Factor = 0%
Unmet Demand Target = Varies

- 71-Year Average
- 1928-34 Dry Period Average
- Dry Year Average
- Critically Dry Year Average
- Minimum Annual

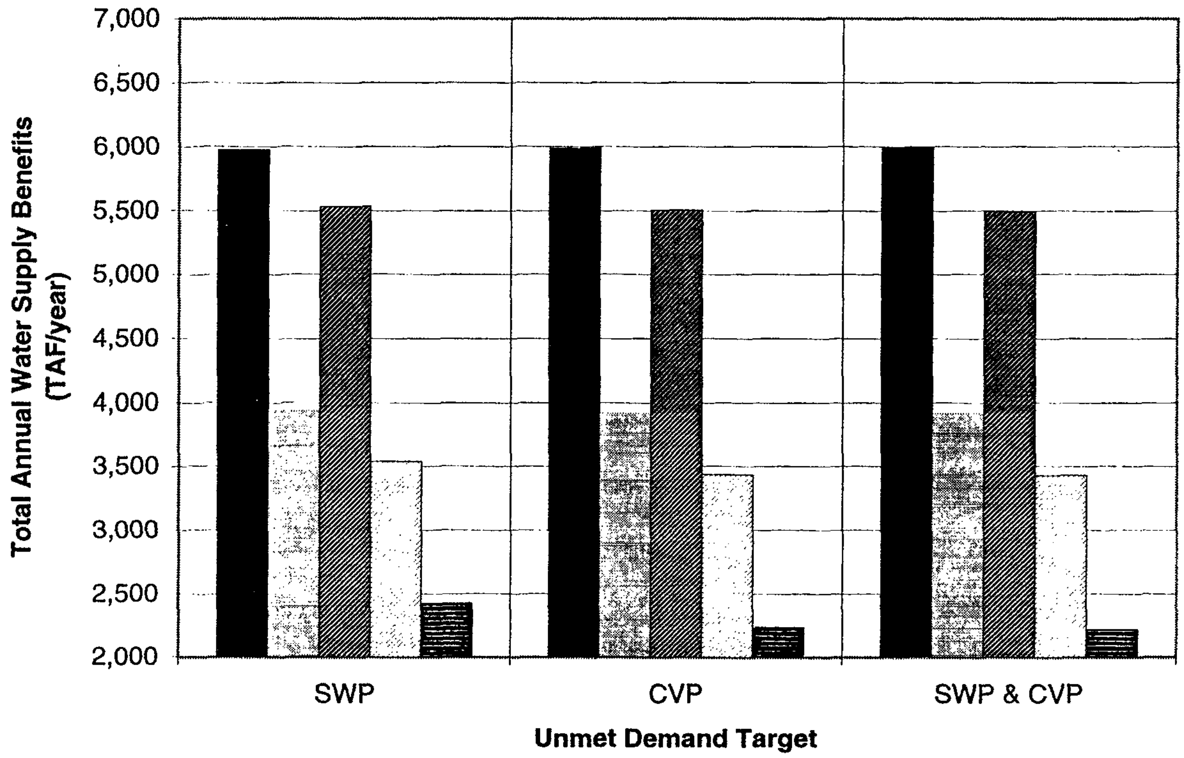
Total Water Supply Benefits (TAF/yr)

Unmet Demand Target:	SWP	CVP	SWP & CVP
71-Year Average:	5,979	5,991	5,996
1928-34 Dry Period Average:	3,944	3,919	3,919
Average of all Dry Years:	5,548	5,503	5,510
Average of all Crit. Dry Years:	3,548	3,433	3,421
Minimum Annual:	2,490	2,206	2,206

SA_DE1.XLS: Bar-Tot Chart 1

Figure SA-8

South of Delta Off-Aqueduct Storage
Ag & Urban Water Supply Benefits versus Unmet Demand Target



Assumptions
Storage Volume = 2.0 MAF
Conveyance Capacity = 3,500 cfs
Existing Banks PP Capacity
A&U Storage Carryover Factor = 30%
Unmet Demand Target = Varies

■ 71-Year Average
■ 1928-34 Dry Period Average
■ Dry Year Average
□ Critically Dry Year Average
■ Minimum Annual

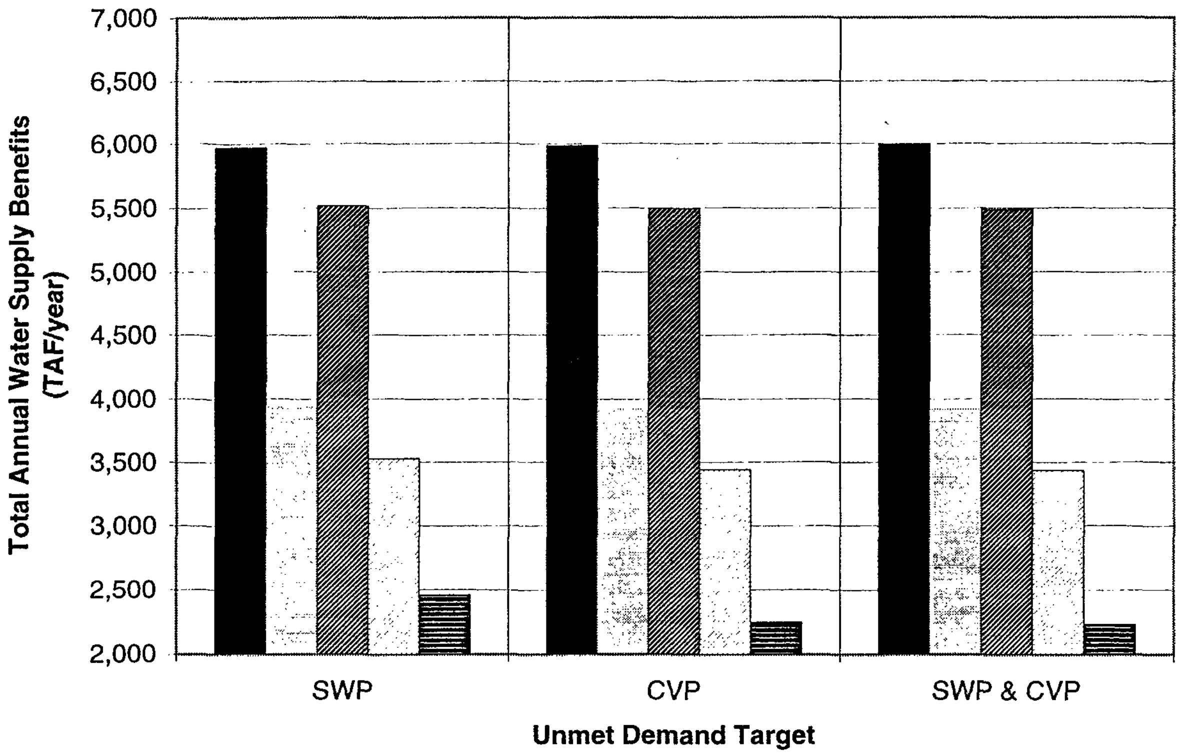
Total Water Supply Benefits (TAF/yr)

Unmet Demand Target:	SWP	CVP	SWP & CVP
71-Year Average:	5,977	5,989	5,995
1928-34 Dry Period Average:	3,943	3,919	3,919
Average of all Dry Years:	5,532	5,505	5,496
Average of all Crit. Dry Years:	3,537	3,435	3,427
Minimum Annual:	2,422	2,233	2.216

SA_DE2.XLS: Bar-Tot Chart 1

Figure SA-9

South of Delta Off-Aqueduct Storage
Ag & Urban Water Supply Benefits versus Unmet Demand Target



Assumptions
Storage Volume = 2.0 MAF
Conveyance Capacity = 3,500 cfs
Existing Banks PP Capacity
A&U Storage Carryover Factor = 50%
Unmet Demand Target = Varies

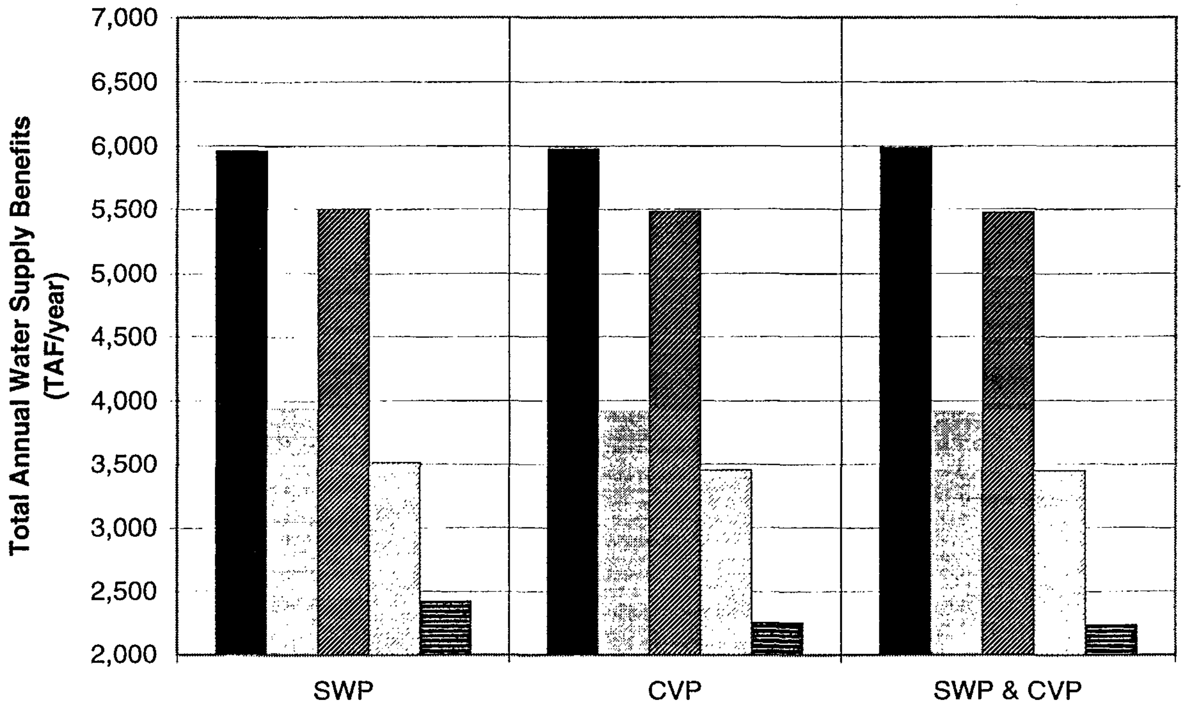
Total Water Supply Benefits (TAF/yr)

Unmet Demand Target:	SWP	CVP	SWP & CVP
71-Year Average:	5,973	5,987	5,993
1928-34 Dry Period Average:	3,941	3,919	3,919
Average of all Dry Years:	5,518	5,496	5,488
Average of all Crit. Dry Years:	3,526	3,441	3,436
Minimum Annual:	2,457	2,243	2.227

SA_DE3.XLS: Bar-Tot Chart 1

Figure SA-10

South of Delta Off-Aqueduct Storage
Ag & Urban Water Supply Benefits versus Unmet Demand Target



Assumptions
Storage Volume = 2.0 MAF
Conveyance Capacity = 3,500 cfs
Existing Banks PP Capacity
A&U Storage Carryover Factor = 70%
Unmet Demand Target = Varies

■ 71-Year Average
▒ 1928-34 Dry Period Average
▨ Dry Year Average
□ Critically Dry Year Average
▤ Minimum Annual

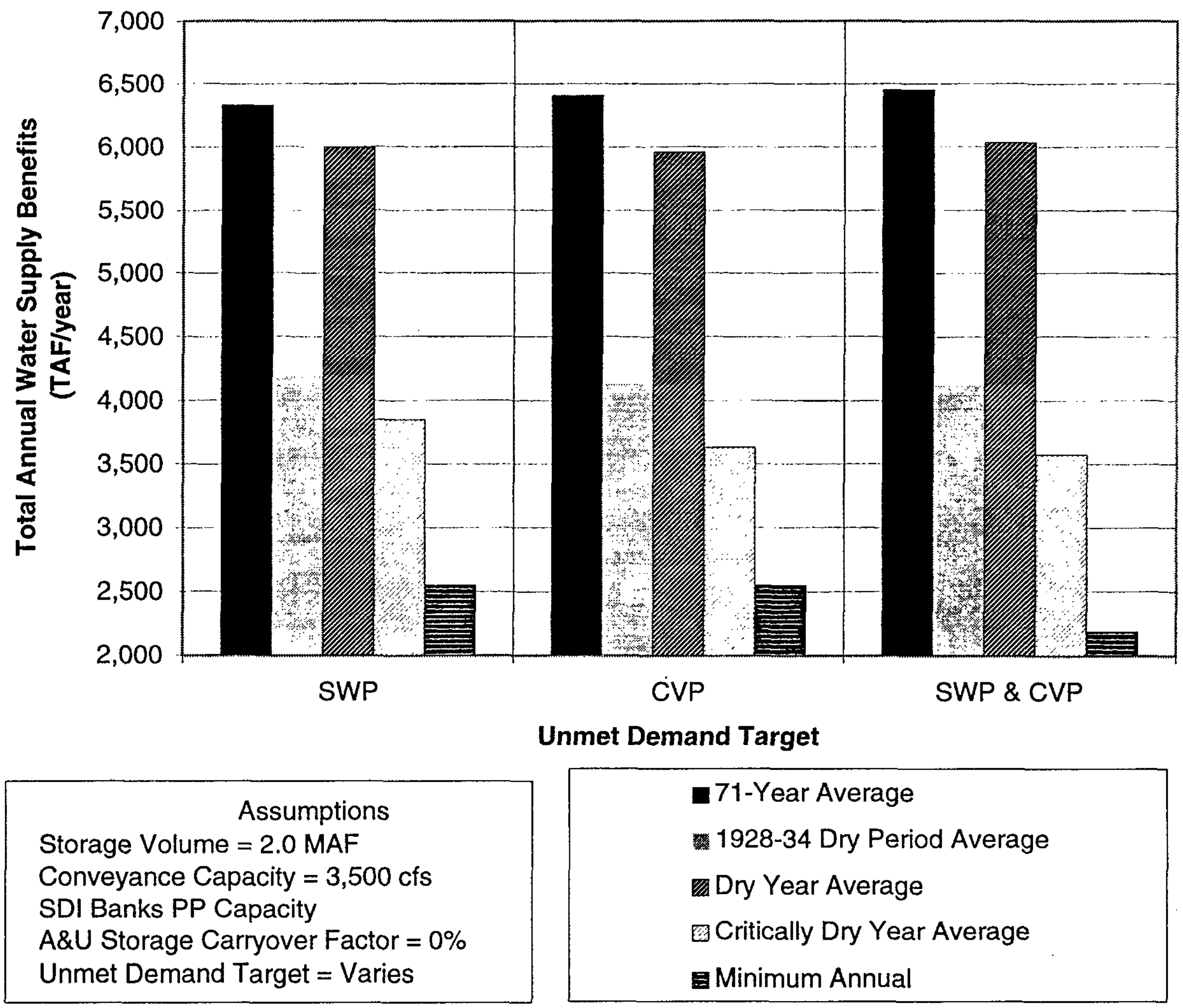
Total Water Supply Benefits (TAF/yr)

Unmet Demand Target:	SWP	CVP	SWP & CVP
71-Year Average:	5,965	5,980	5,988
1928-34 Dry Period Average:	3,940	3,919	3,919
Average of all Dry Years:	5,499	5,481	5,475
Average of all Crit. Dry Years:	3,513	3,454	3,448
Minimum Annual:	2,422	2,252	2.236

SA_DE4.XLS: Bar-Tot Chart 1

Figure SA-11

South of Delta Off-Aqueduct Storage Ag & Urban Water Supply Benefits versus Unmet Demand Target



Assumptions
Storage Volume = 2.0 MAF
Conveyance Capacity = 3,500 cfs
SDI Banks PP Capacity
A&U Storage Carryover Factor = 0%
Unmet Demand Target = Varies

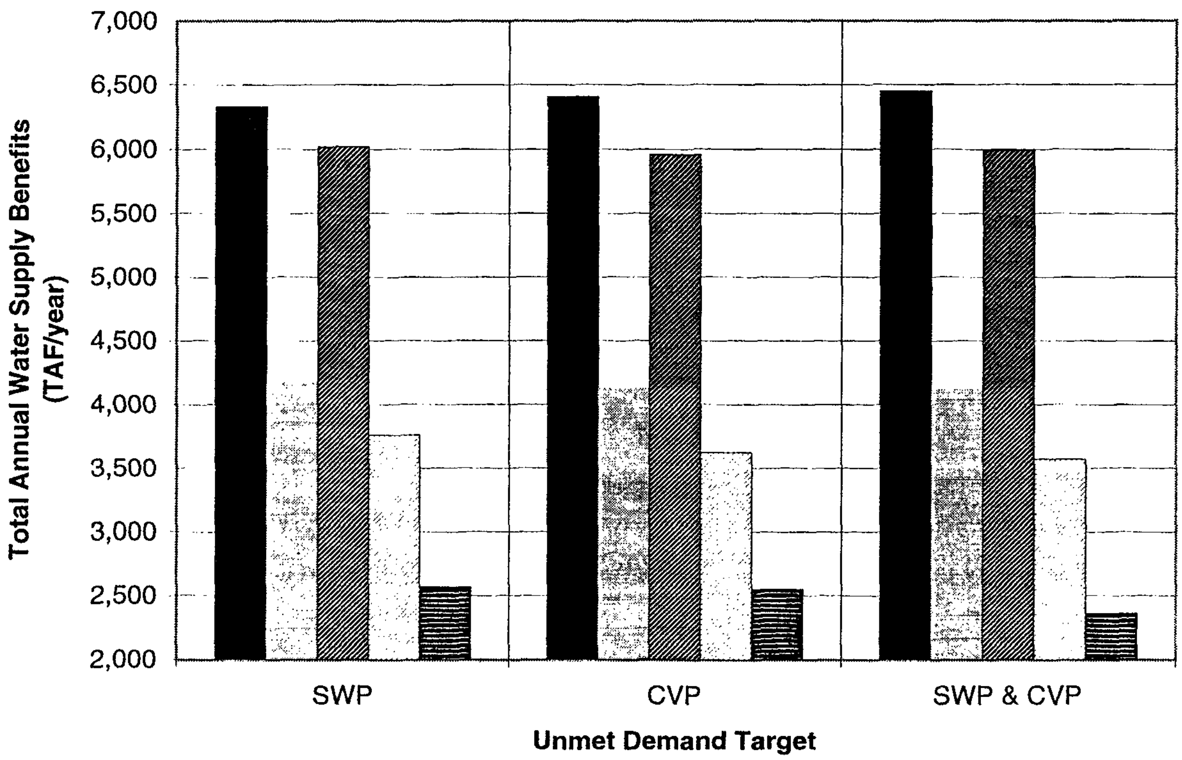
Total Water Supply Benefits (TAF/yr)

Unmet Demand Target:	SWP	CVP	SWP & CVP
71-Year Average:	6,335	6,410	6,455
1928-34 Dry Period Average:	4,184	4,124	4,118
Average of all Dry Years:	5,992	5,957	6,034
Average of all Crit. Dry Years:	3,849	3,631	3,571
Minimum Annual:	2,547	2,547	2.184

SA_DE5.XLS: Bar-Tot Chart 1

Figure SA-12

South of Delta Off-Aqueduct Storage Ag & Urban Water Supply Benefits versus Unmet Demand Target



Assumptions
Storage Volume = 2.0 MAF
Conveyance Capacity = 3,500 cfs
SDI Banks PP Capacity
A&U Storage Carryover Factor = 30%
Unmet Demand Target = Varies

- 71-Year Average
- 1928-34 Dry Period Average
- Dry Year Average
- Critically Dry Year Average
- Minimum Annual

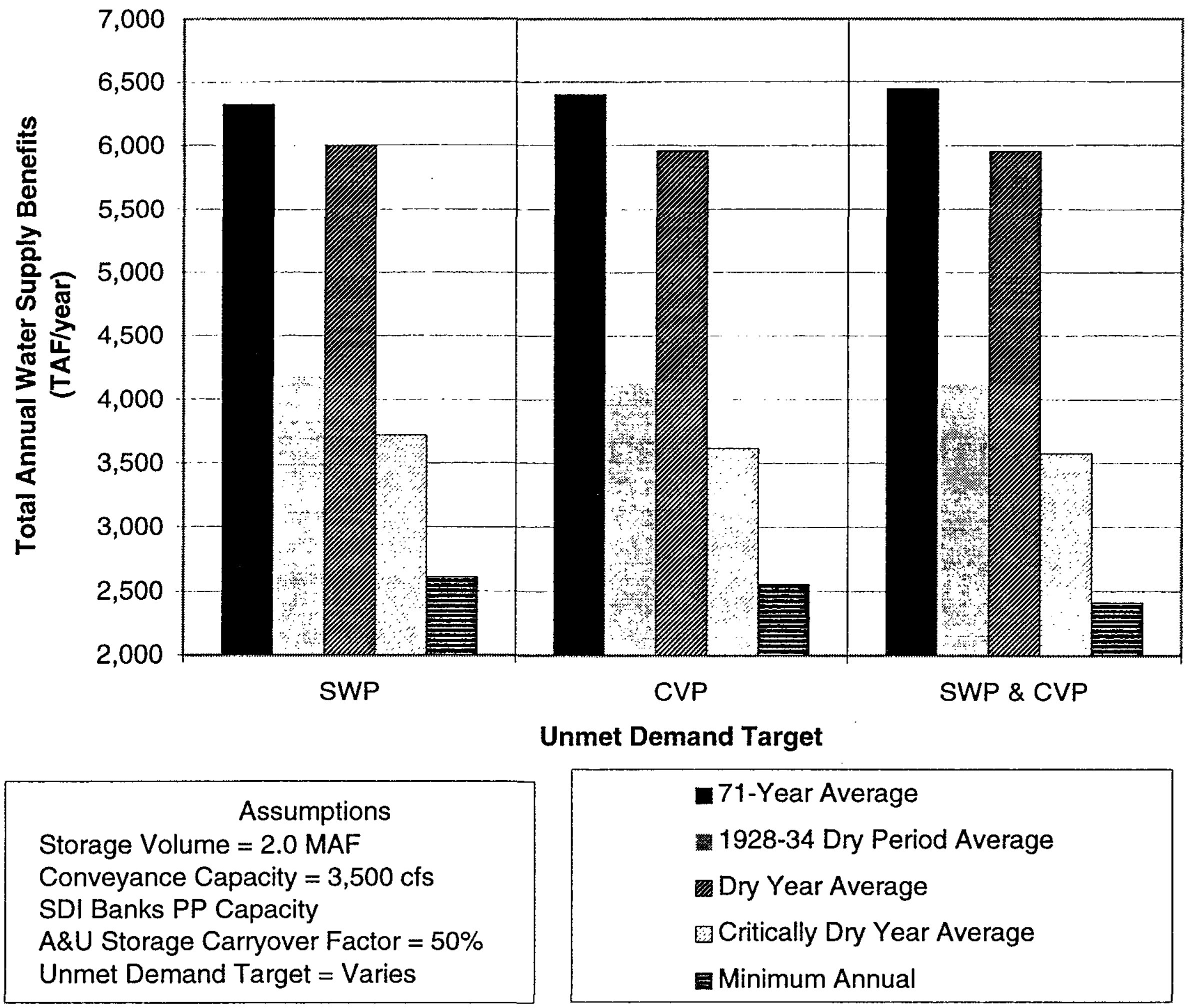
Total Water Supply Benefits (TAF/yr)

Unmet Demand Target:	SWP	CVP	SWP & CVP
71-Year Average:	6,331	6,407	6,452
1928-34 Dry Period Average:	4,181	4,127	4,119
Average of all Dry Years:	6,019	5,958	5,992
Average of all Crit. Dry Years:	3,763	3,624	3,573
Minimum Annual:	2,564	2,547	2.360

SA_DE6.XLS: Bar-Tot Chart 1

Figure SA-13

South of Delta Off-Aqueduct Storage
Ag & Urban Water Supply Benefits versus Unmet Demand Target



Assumptions
Storage Volume = 2.0 MAF
Conveyance Capacity = 3,500 cfs
SDI Banks PP Capacity
A&U Storage Carryover Factor = 50%
Unmet Demand Target = Varies

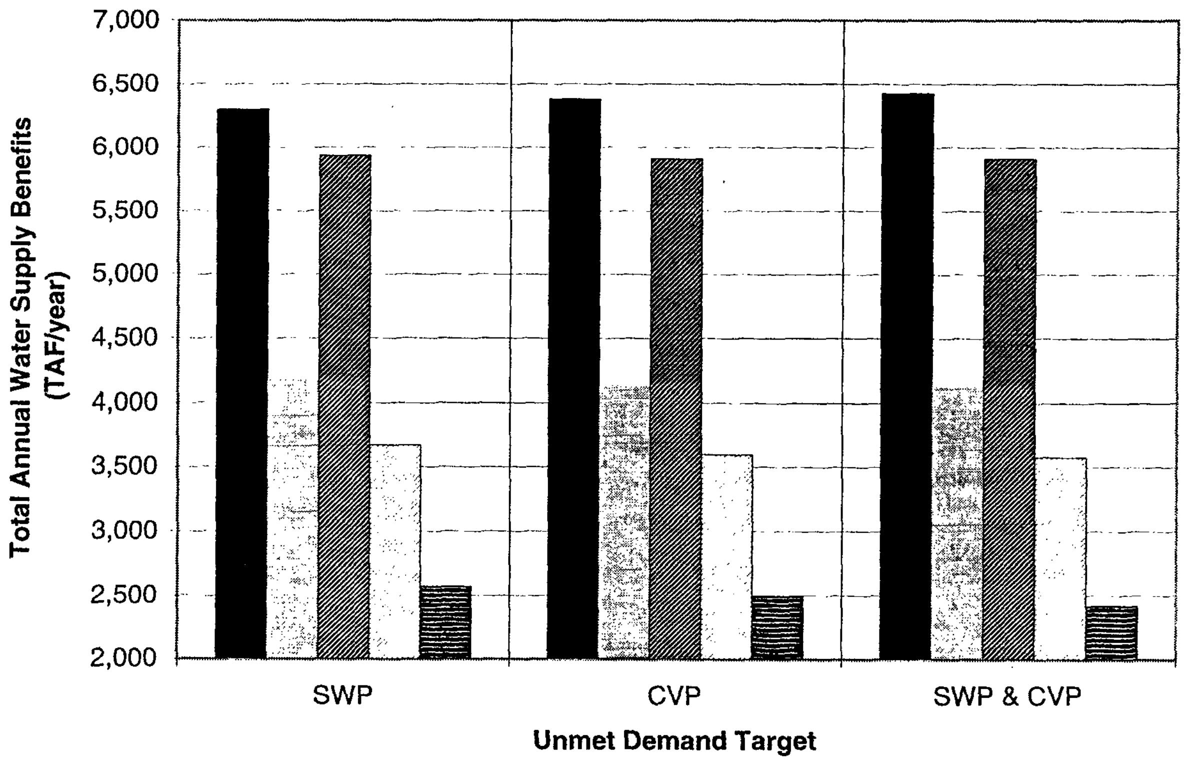
Total Water Supply Benefits (TAF/yr)

Unmet Demand Target:	SWP	CVP	SWP & CVP
71-Year Average:	6,323	6,403	6,447
1928-34 Dry Period Average:	4,179	4,129	4,120
Average of all Dry Years:	5,995	5,954	5,949
Average of all Crit. Dry Years:	3,716	3,615	3,574
Minimum Annual:	2,607	2,554	2.410

SA_DE7.XLS: Bar-Tot Chart 1

Figure SA-14

South of Delta Off-Aqueduct Storage Ag & Urban Water Supply Benefits versus Unmet Demand Target



Assumptions
Storage Volume = 2.0 MAF
Conveyance Capacity = 3,500 cfs
SDI Banks PP Capacity
A&U Storage Carryover Factor = 70%
Unmet Demand Target = Varies

Total Water Supply Benefits (TAF/yr)

Unmet Demand Target:	SWP	CVP	SWP & CVP
71-Year Average:	6,307	6,389	6,432
1928-34 Dry Period Average:	4,175	4,131	4,121
Average of all Dry Years:	5,933	5,908	5,910
Average of all Crit. Dry Years:	3,667	3,595	3,575
Minimum Annual:	2,570	2,495	2.416

SA_DE8.XLS: Bar-Tot Chart 1

Selection of Bracketing Operational Parameter Sets

As described in the previous sections, sensitivity analyses were conducted using the CALFED spreadsheet operations model to identify the effects of various operational parameters on environmental water supply benefits. Using the information developed through this process, parameter sets were selected to represent the four bracketing operation conditions described in Table SA-1.

Parameter sets which maximized 71-Year Average Annual Agricultural and Urban Water Supply Benefits were chosen for the Normal Period Supply Operation conditions. Emphasizing this long-term average clearly results in the largest quantity of total water supply deliveries over normal hydrologic periods. Developing a rational for selecting parameter sets for Dry Period Supply Operation conditions is more complex. In general, the sensitivity analyses described above show that more aggressive storage operations (lower storage carryover requirements, higher unmet demand targets) result in larger Average Dry Year, Average Critically Dry Year, or 1928-34 Critical Dry Period Average Annual Agricultural and Urban Water Supply Benefits. When examined in detail, however, it was found the large averages are often due to a particularly large storage release in one or two years, while no benefits are provided during many other critical years. Minimum Annual Agricultural and Urban Water Supply Benefits were maximized with more conservative operating criteria (higher storage carryover requirements and lower unmet demand targets); however, maximizing minimum annual deliveries may not be a cost-effective operational goal for agricultural and urban water supply benefits. To provide a reasonable bracketing operation condition, it was decided to use a 50 percent storage carryover factor and SWP-only unmet demand target for Dry Period Supply Operations. This set of operation parameters provides a more uniform distribution of water supply benefits in dry and critically dry years, with minimal impacts to normal period average benefits.

Parameter sets for Normal Period Supply Operation and Dry Period Supply Operation were identified for the two external conditions considered in this evaluation, existing Banks Pumping Plant capacity and expanded Banks Pumping Plant capacity. The resulting parameter sets for each of the four bracketing operation conditions are detailed in Table SA-7.

Table SA-7

South of Delta Off-Aqueduct Storage
Selected Parameter Sets for Bracketing Operational Conditons

Operational Condition	Parameter Sets
A. Existing Banks PP Capacity -- Normal Period Supply Operation	Existing Banks PP Capacity Storage Carryover Factor = 0% Unmet Demand Target = SWP & CVP
B. Existing Banks PP Capacity -- Dry Period Supply Operation	Existing Banks PP Capacity Storage Carryover Factor = 50% Unmet Demand Target = SWP
C. Expanded Banks PP Capacity -- Normal Period Supply Operation	SDI Banks PP Capacity Storage Carryover Factor = 0% Unmet Demand Target = SWP & CVP
D. Expanded Banks PP Capacity -- Dry Period Supply Operation	SDI Banks PP Capacity Storage Carryover Factor = 50% Unmet Demand Target = SWP

SA_RVSM.XLS: Conditions Table

Comparison of Bracketing Operation Conditions

Model Runs

Model runs were completed for each of the four operation conditions using the parameter sets described in Table SA-7. For comparative purposes, maximum storage volume was set at 2.0 maf with a 3,500 cfs inflow/outflow capacity. Table SA-8 compares the total and net increased Agricultural and Urban Water Supply Benefits under each operation condition.

Evaluation

The Normal Period Supply and Dry period Supply Operation conditions bracket the range of potential storage operations. Normal Period Supply Operation maximizes total average water supply benefits, as measured by the 71-Year Average Annual Agricultural and Urban Water Supply Benefits. Dry Period Supply Operation maximizes water supply benefits in extremely dry years, as measured by the Minimum Annual Agricultural and Urban Water Supply Benefits. Contrasting these bracketing operations for the existing Banks Pumping Plant capacity condition, Normal Period Supply Operation (Condition A) results in a net benefit of 75 taf in 71-Year Average Annual Agricultural and Urban Water Supply Benefits, as compared to a net benefit of 52 taf under Dry Period Supply Operation (Condition B). Conversely, Dry Period Supply Operation (Condition B) results in a net benefit of 250 taf in Minimum Annual Agricultural and Urban Water Supply Benefits, compared to a net benefit of 0 taf in Minimum Annual Agricultural and Urban Water Supply Benefits under Normal Period Supply Operation (Condition A).

More significant benefits are achieved under the expanded Banks Pumping Plant capacity conditions. Contrasting the bracketing Operation Conditions C and D, Normal period Supply Operation (Condition C) results in a net benefit of 286 taf in 71-Year Average Annual Agricultural and Urban Water Supply Benefits, as compared to a net benefit of 52 taf under Dry Period Supply Operation (Condition D). Conversely, Dry Period Supply Operation (Condition D) results in a net benefit of 423 taf in Minimum Annual Agricultural and Urban Water Supply Benefits, compared to a net benefit of 0 taf in Minimum Annual Agricultural and Urban Water Supply Benefits under Normal Period Supply Operation (Condition C).

Figures SA-15 and SA-16 compare the relative effects of the four operation conditions on an annual basis. In these charts, bars represent the total Agricultural and Urban Water Supply Benefits for the 71 years used in the model simulations, sorted from minimum to maximum. For comparison, base case Agricultural and Urban Water Supply Benefits is represented with a line in each chart. Figure SA-15 compares Normal Period Supply and Dry Period Supply Operations for the existing Banks Pumping Plant capacity condition. While minor benefits are seen during drier years under Dry Period Supply Operation (Condition B), benefits during average and above-average water years are significantly reduced. Similarly, Figure SA-16 compares Normal Period Supply and Dry Period Supply Operations for the expanded Banks Pumping Plant capacity condition. More significant benefits occur during the very driest years under Dry Period Supply Operation (Condition D); however, benefits during average-type water years are once again significantly reduced in comparison to Normal Period Supply Operation.

Figure SA-17 presents the same data used in Figures SA-15 and SA-16 in a frequency-of-exceedence format. In this chart, total annual Agricultural and Urban Water Supply Benefits for the base case and the four operation conditions are plotted against frequency of exceedence. As described above, significantly higher benefits in average-type years are shown with Normal Period Supply Operation, with relatively smaller net gains in drier years under Dry Period Supply Operation.

To provide a better understanding of the year-to-year operations that occur under the four bracketing operation conditions, Figures SA-18 through SA-21 display the simulated storage releases that occur throughout the 71-year hydrological sequence. In each chart, bars represent annual volumes of storage releases and a solid line represents the annual volume of water required to fully meet the combined SWP and CVP unmet demand targets. In Dry Period Supply Operations, the SWP-only unmet demand target was used to control storage operations. A dashed line represents the annual volume of water required to meet this operational target. As can be seen in these charts, under Normal Period Supply Operations (Conditions A and C) larger annual volumes of water are released in relatively few years of the 71-year hydrologic sequence. Under Dry Period Supply Operations (Conditions B and D), annual releases are much smaller, but occur on a much more frequent basis.

Simulated end-of-month storage volumes for the four bracketing operation conditions are shown in Figures SA-22 through SA-25. As expected, storage volumes show sharper draw downs and larger variability under Normal Period Supply Operations (Conditions A and C) in comparison to Dry Period Supply Operations (Conditions B and D). Under Conditions A and B (Existing Banks Pumping Plant), the maximum storage volume of 2.0 maf is reached in only one year of the 71-year hydrologic sequence. Contrarily, under Condition D (Expanded Banks Pumping Plant Capacity -- Dry Period Supply Operation), the 2.0 maf storage volume fills in 17 years of the 71-year hydrologic sequence.

Table SA-8

South of Delta Off-Aqueduct Storage
Ag & Urban Water Supply Benefit vs. Operational Condition
for 2.0 MAF Maximum Storage Capacity

(Values in thousands of acre-feet)

Ag & Urban Water Supply Benefits	Base 1	Base 2	Operation Condition A SA208		Operation Condition B SA219		Operation Condition C SA230		Operation Condition D SA241	
	Base Case with Existing Banks PP Capacity	Base Case with SDI Banks PP Capacity	Total Water Supply Benefits	Net Benefit	Total Water Supply Benefits	Net Benefit	Total Water Supply Benefits	Net Benefit	Total Water Supply Benefits	Net Benefit
71-Year Average	5,921	6,169	5,996	75	5,973	52	6,455	286	6,323	154
1928-34 Dry Period Average	3,918	4,033	3,919	1	3,941	23	4,118	85	4,179	145
Dry Year Average	5,374	5,635	5,510	137	5,518	144	6,034	399	5,995	360
Critically Dry Year Average	3,421	3,480	3,421	0	3,526	105	3,571	91	3,716	237
Minimum Annual	2,206	2,184	2,206	0	2,457	250	2,184	0	2,607	423

[1]See Table SA-X for description of operational conditions.

SA_RVSM.XLS: Results 2000

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Figure SA-15

South of Delta Off-Aqueduct Storage
Ag & Urban Water Supply Benefits Under a Range of Operational Conditions

A. Existing Banks PP Capacity -- Normal Period Supply Operation

B. Existing Banks PP Capacity -- Dry Period Supply Operation

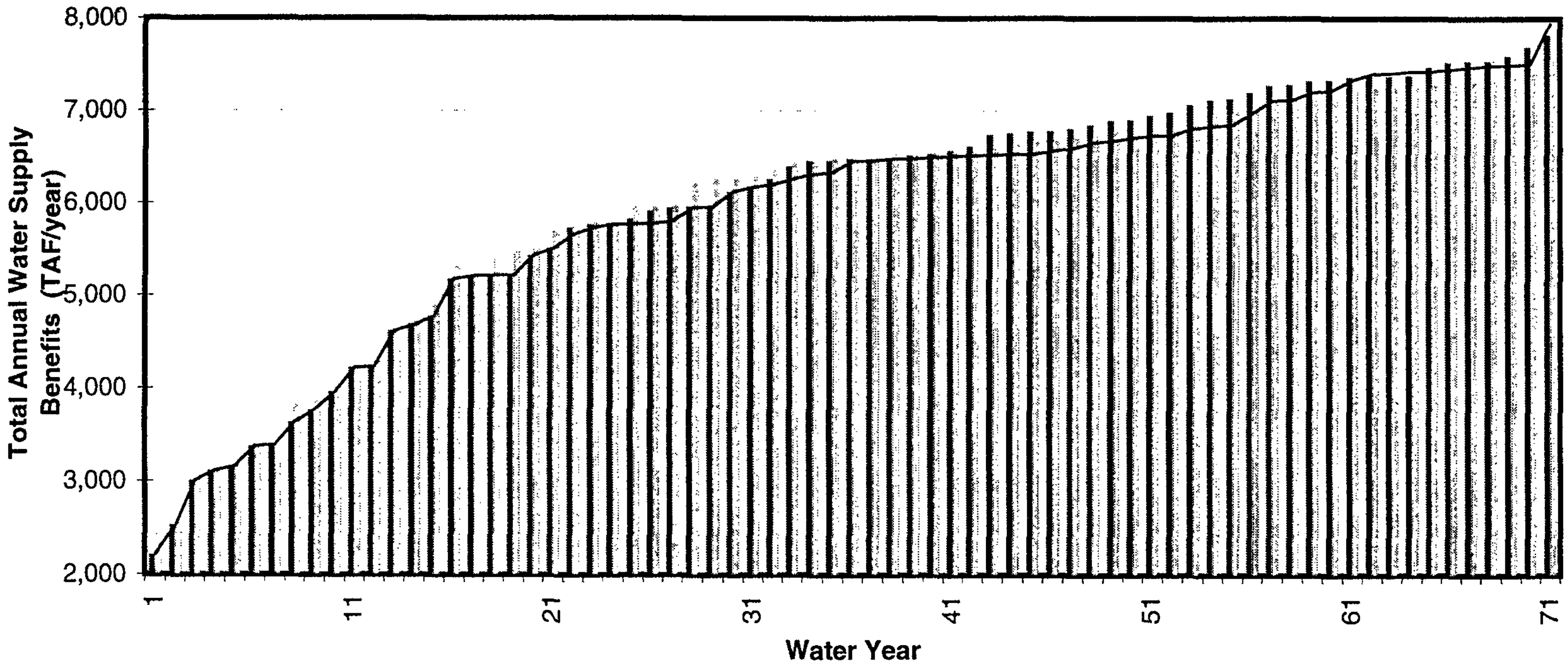
—— Base Case (No Storage, Existing Banks Cap.)

Assumptions

Maximum Storage Capacity = 2.0 MAF
Conveyance Capacity = 3,500 cfs

Total Water Supply Benefits (TAF/yr)

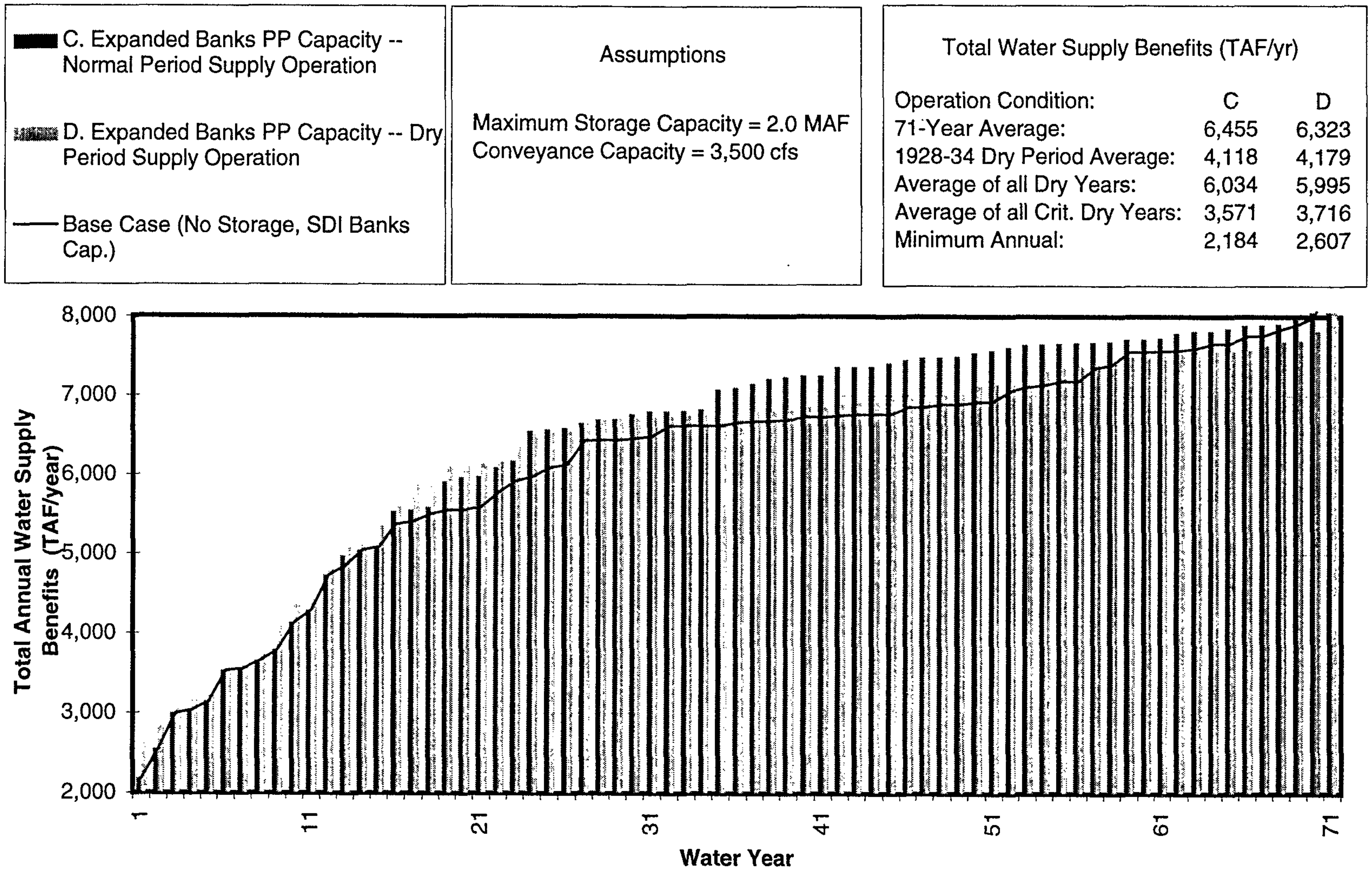
Operation Condition:	A	B
71-Year Average:	5,996	5,973
1928-34 Dry Period Average:	3,919	3,941
Average of all Dry Years:	5,510	5,518
Average of all Crit. Dry Years:	3,421	3,526
Minimum Annual:	2,206	2,457



SA_OP1.XLS: Sort-Tot Chart 1

Figure SA-16

South of Delta Off-Aqueduct Storage
Ag & Urban Water Supply Benefits Under a Range of Operational Conditions

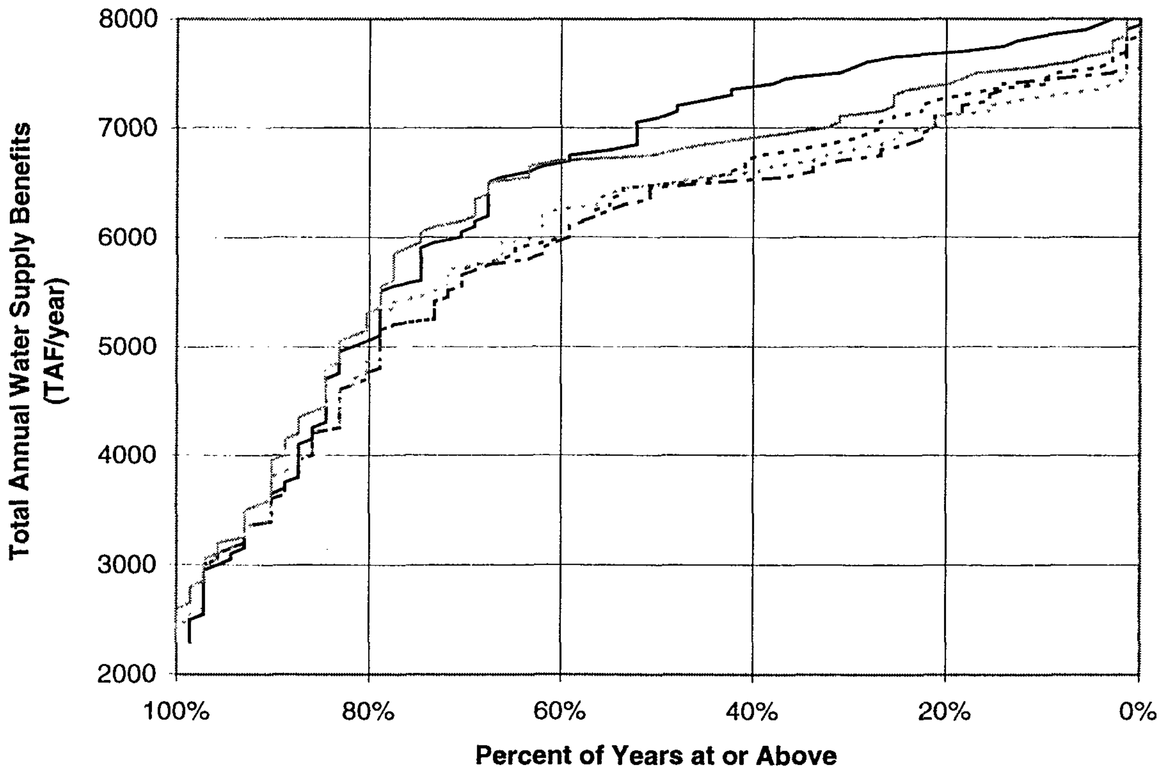


Operation Condition:	C	D
71-Year Average:	6,455	6,323
1928-34 Dry Period Average:	4,118	4,179
Average of all Dry Years:	6,034	5,995
Average of all Crit. Dry Years:	3,571	3,716
Minimum Annual:	2,184	2,607

SA_OP1.XLS: Sort-Tot Chart 2

Figure SA-17

South of Delta Off-Aqueduct Storage Ag & Urban Water Supply Benefits Under a Range of Operational Conditions



Assumptions

Maximum Storage Capacity = 2.0 MAF
Conveyance Capacity = 3,500 cfs

- Base Case (No Storage, Existing Banks Cap.)
- A. Existing Banks PP Capacity -- Normal Period Supply Operation
- B. Existing Banks PP Capacity -- Dry Period Supply Operation
- C. Expanded Banks PP Capacity -- Normal Period Supply Operation
- D. Expanded Banks PP Capacity -- Dry Period Supply Operation

Total Water Supply Benefits (TAF/yr)

Operation Condition:	A	B	C	D
71-Year Average:	5,996	5,973	6,455	6,323
1928-34 Dry Period Average:	3,919	3,941	4,118	4,179
Average of all Dry Years:	5,510	5,518	6,034	5,995
Average of all Crit. Dry Years:	3,421	3,526	3,571	3,716
Minimum Annual:	2,206	2,457	2,184	2,607

SA_OP1.XLS: Freq-Tot Chart 1

Figure SA-18

South of Delta Off-Aqueduct Storage
Ag & Urban Water Supply Benefits Under Operations Condition A
Existing Banks PP Capacity-- Normal Period Supply Operation

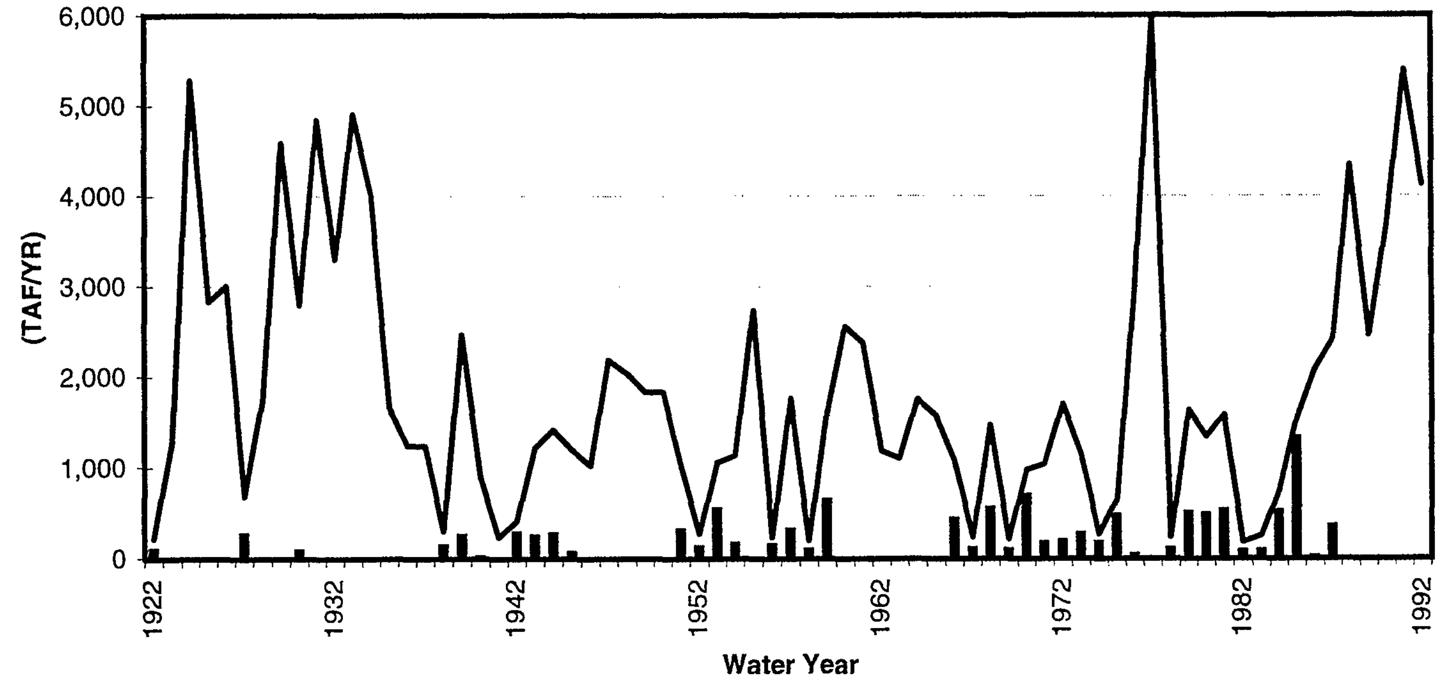
Releases from Storage

Unmet SWP &CVP Demand

Assumptions

Maximum Storage Capacity = 2.0 MAF
Conveyance Capacity = 3,500 cfs

Total Water Supply Benefits (TAF/yr)	
Operation Condition:	A
71-Year Average:	5,996
1928-34 Dry Period Average:	3,919
Average of all Dry Years:	5,510
Average of all Crit. Dry Years:	3,421
Minimum Annual:	2,206



SA_OP1.XLS: Outflow Plot A

Figure SA-19

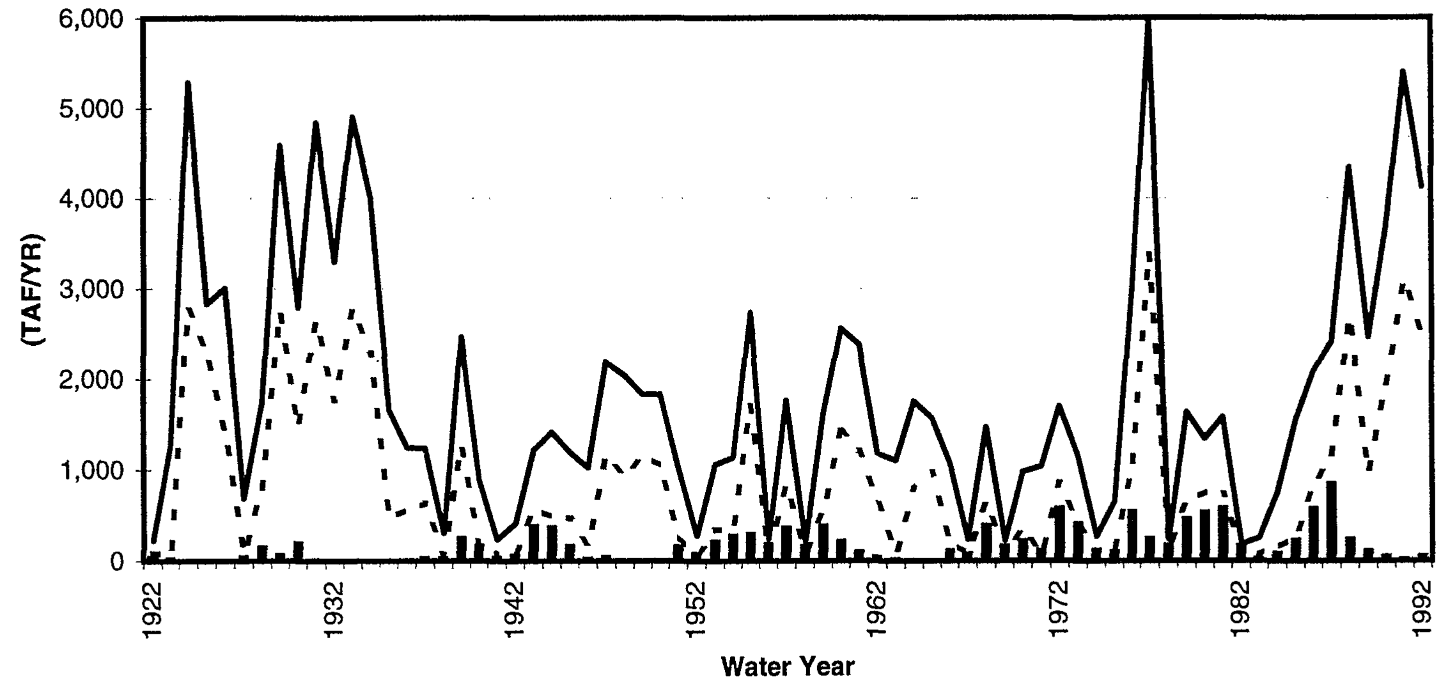
South of Delta Off-Aqueduct Storage
Ag & Urban Water Supply Benefits Under Operations Condition B
Existing Banks PP Capacity -- Dry Period Supply Operation

Releases from Storage
Unmet SWP Demand
Unmet SWP &CVP Demand

Assumptions

Maximum Storage Capacity = 2.0 MAF
Conveyance Capacity = 3,500 cfs

Total Water Supply Benefits (TAF/yr)	
Operation Condition:	B
71-Year Average:	5,973
1928-34 Dry Period Average:	3,941
Average of all Dry Years:	5,518
Average of all Crit. Dry Years:	3,526
Minimum Annual:	2,457



SA_OP1.XLS: Outflow Plot B

Figure SA-20

South of Delta Off-Aqueduct Storage
Ag & Urban Water Supply Benefits Under Operations Condition C
Expanded Banks PP Capacity -- Normal Period Supply Operation

Releases from Storage

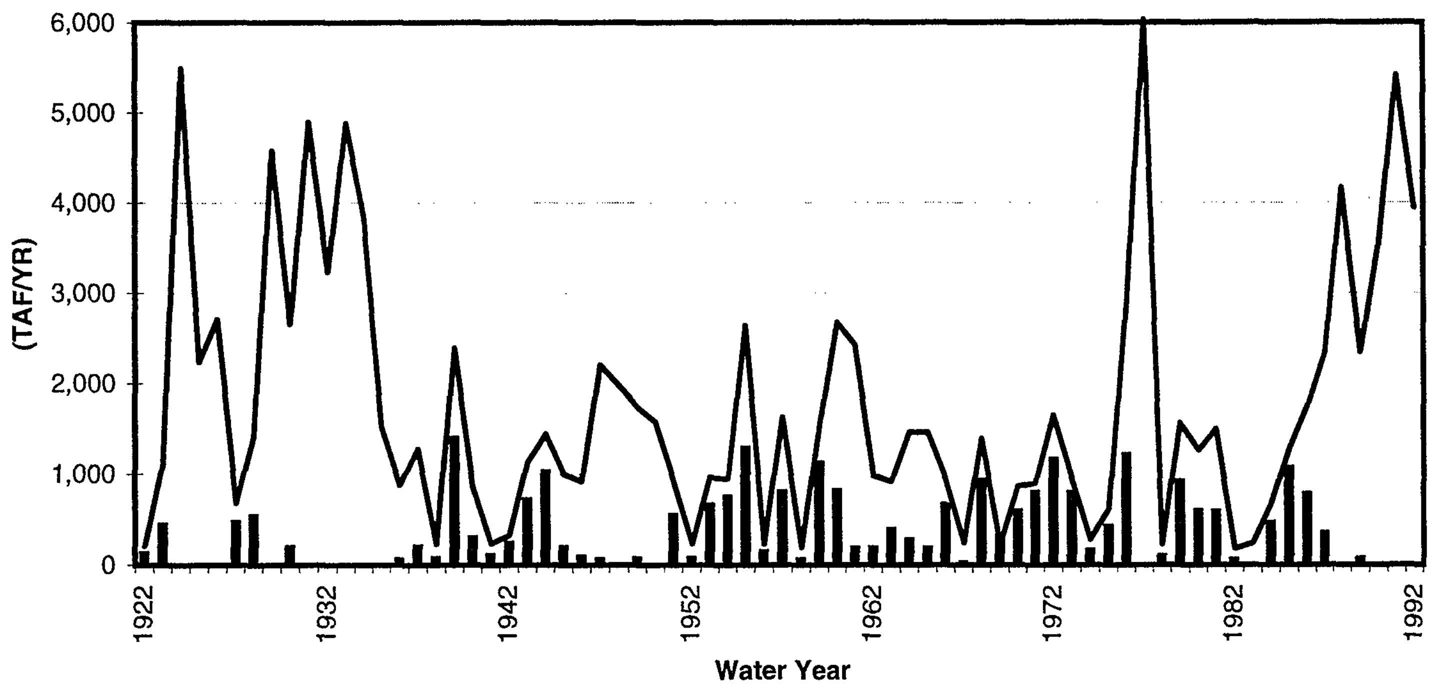
Unmet SWP &CVP Demand

Assumptions

Maximum Storage Capacity = 2.0 MAF
Conveyance Capacity = 3,500 cfs

Total Water Supply Benefits (TAF/yr)

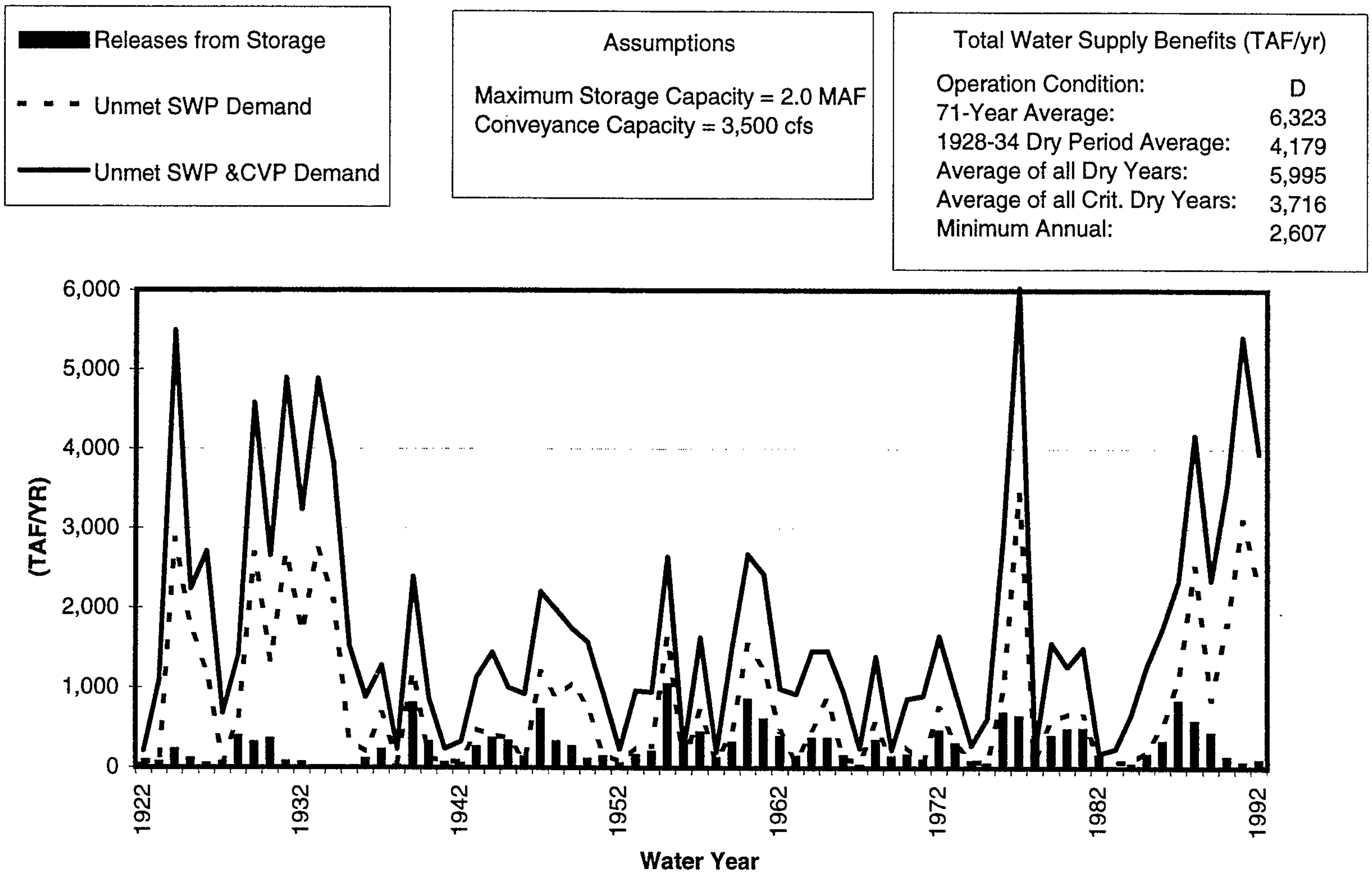
Operation Condition:	C
71-Year Average:	6,455
1928-34 Dry Period Average:	4,118
Average of all Dry Years:	6,034
Average of all Crit. Dry Years:	3,571
Minimum Annual:	2,184



SA_OP1.XLS: Outflow Plot C

Figure SA-21

South of Delta Off-Aqueduct Storage
Ag & Urban Water Supply Benefits Under Operations Condition D
Expanded Banks PP Capacity -- Dry Period Supply Operation

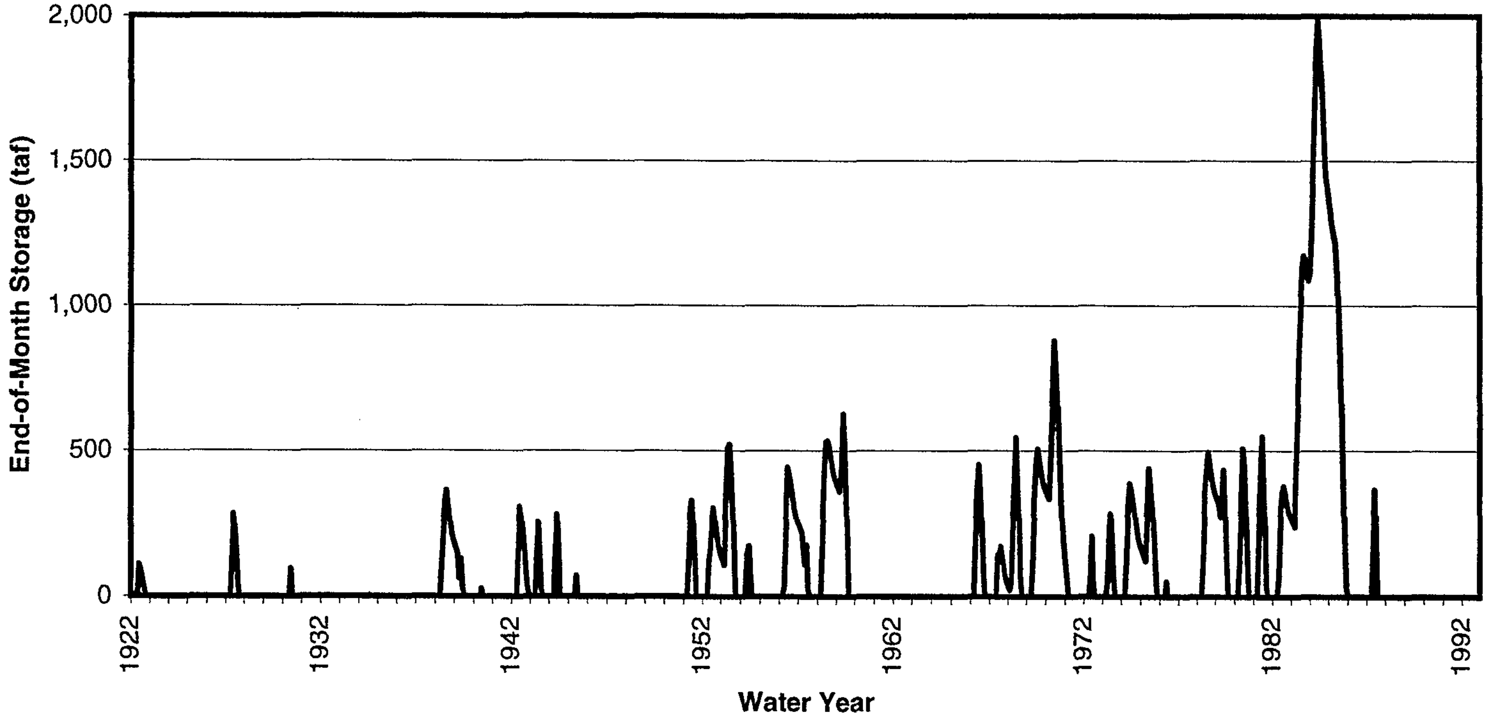


SA_OP1.XLS: Outflow Plot D

Figure SA-22

South of Delta Off-Aqueduct Storage
End-of-Month Storage Volume Under Operations Condition A
Existing Banks PP Capacity-- Normal Period Supply Operation

Assumptions
Maximum Storage Capacity = 2.0 MAF
Conveyance Capacity = 3,500 cfs
Existing Banks PP Capacity
A&U Storage Carryover Factor = 0%
Unmet Demand Target = SWP&CVP

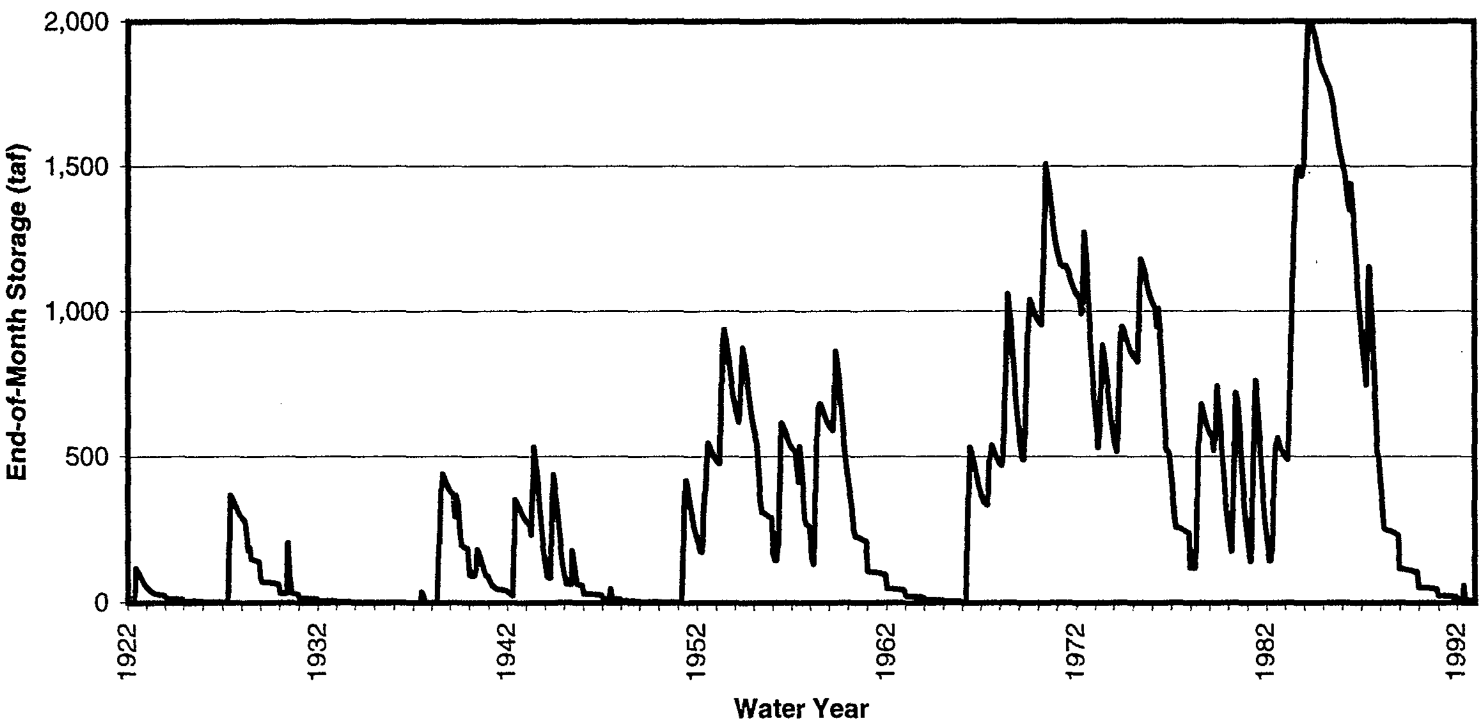


SA_OP1.XLS: EOM Storage A

Figure SA-23

South of Delta Off-Aqueduct Storage
End-of-Month Storage Volume Under Operations Condition B
Existing Banks PP Capacity -- Dry Period Supply Operation

Assumptions
- Maximum Storage Capacity = 2.0 MAF
- Conveyance Capacity = 3,500 cfs
- Existing Banks PP Capacity
- A&U Storage Carryover Factor = 50%
- Unmet Demand Target = SWP

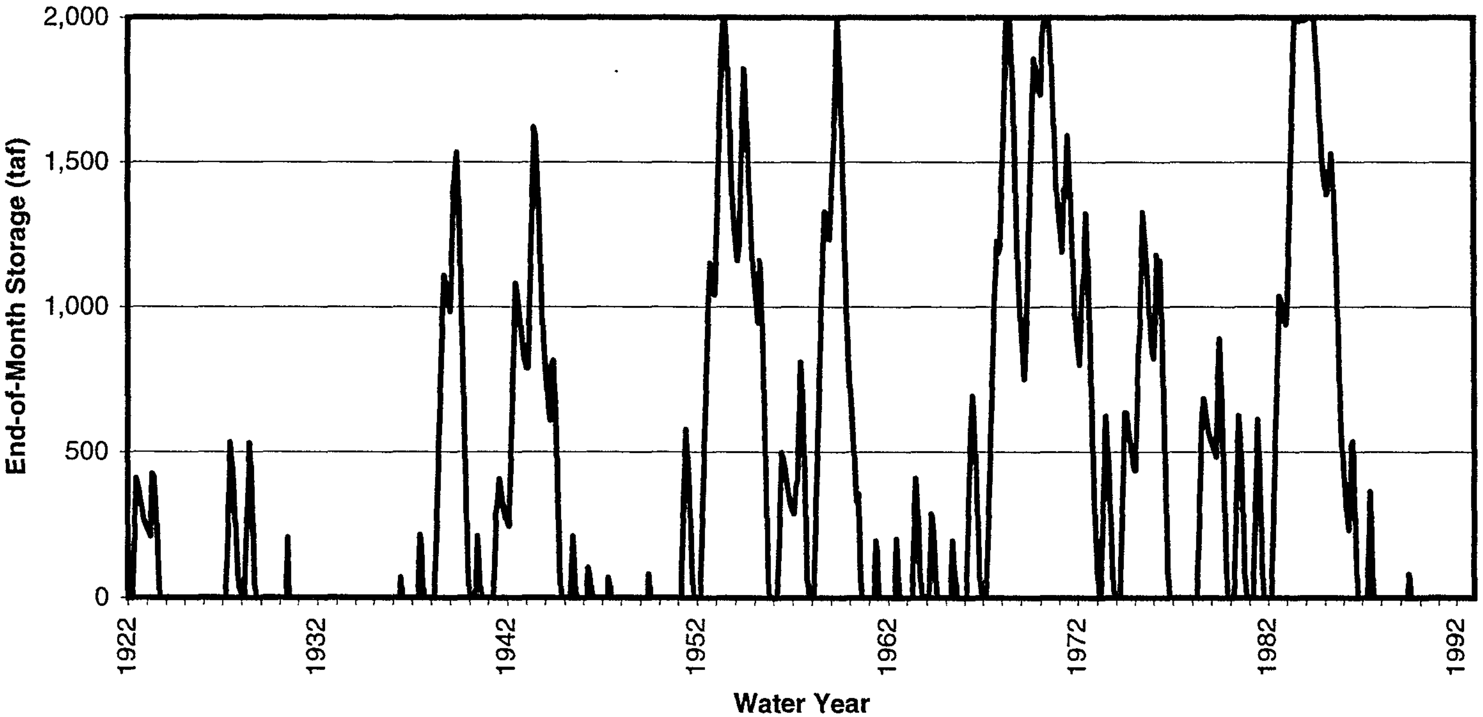


SA_OP1.XLS: EOM Storage B

Figure SA-24

South of Delta Off-Aqueduct Storage
End-of-Month Storage Volume Under Operations Condition C
Expanded Banks PP Capacity -- Normal Period Supply Operation

Assumptions
Maximum Storage Capacity = 2.0 MAF
Conveyance Capacity = 3,500 cfs
SDI Banks PP Capacity
A&U Storage Carryover Factor = 0%
Unmet Demand Target = SWP&CVP

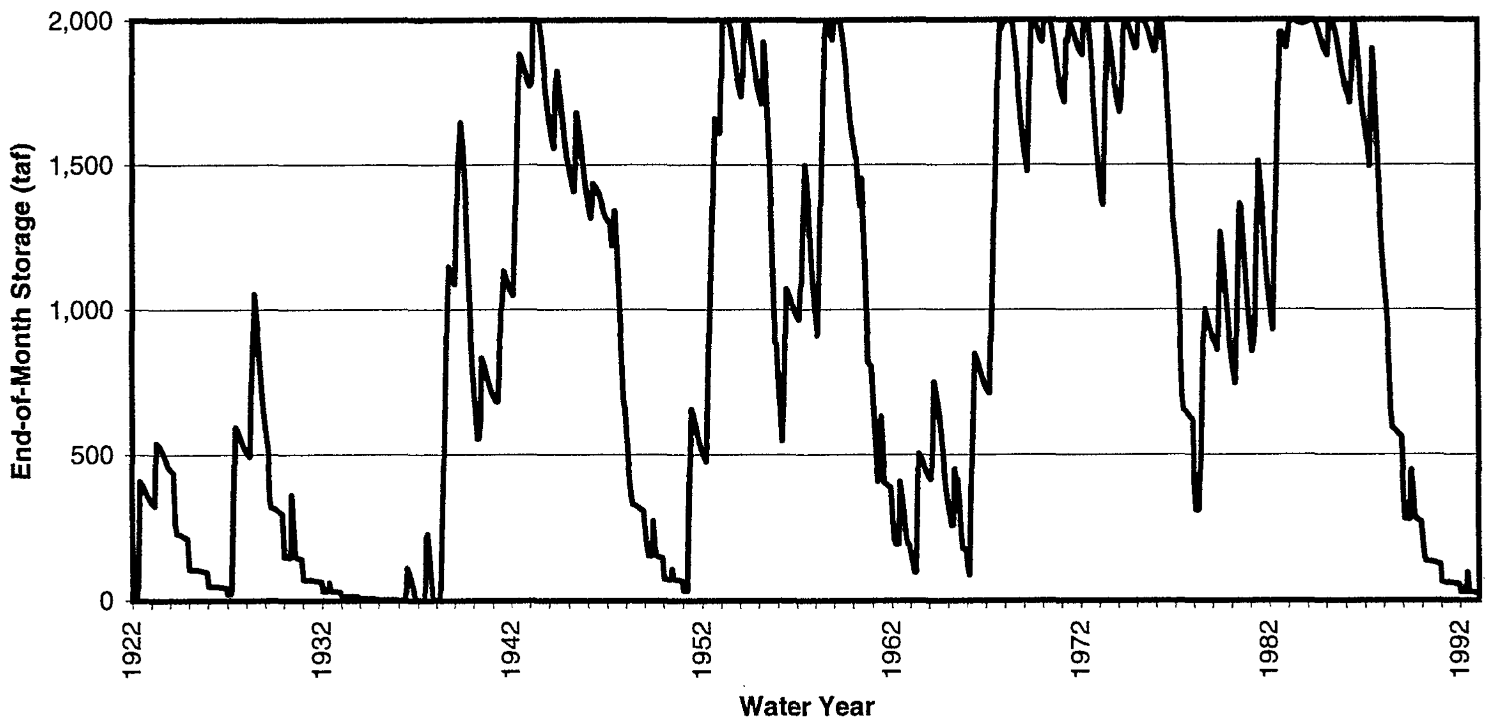


SA_OP1.XLS: EOM Storage C

Figure SA-25

South of Delta Off-Aqueduct Storage
End-of-Month Storage Volume Under Operations Condition D
Expanded Banks PP Capacity -- Dry Period Supply Operation

Assumptions
Maximum Storage Capacity = 2.0 MAF
Conveyance Capacity = 3,500 cfs
SDI Banks PP Capacity
A&U Storage Carryover Factor = 0%
Unmet Demand Target = SWP



SA_OP1.XLS: EOM Storage D

Water Supply Benefits versus Maximum Storage Volume

Model Runs

Maximum storage volumes ranging from 100 taf to 2.0 maf were varied in a set of model runs that simulated the four bracketing operation conditions described previously. These model runs are described in Table SA-9 and summary results are displayed in Tables SA-10 and SA-11. For comparability, all results are measured using total south of Delta SWP and CVP water supply deliveries.

Evaluation

Table SA-10 displays the five statistical measures of total Agricultural and Urban Water Supply Benefits achieved over the range of maximum storage volumes studied for each of the bracketing operation conditions. Table SA-11 displays net increases in Agricultural and Urban Water Supply Benefits for the same range of maximum storage volumes and operation conditions. Figures SA-26 through SA-30 display plots of total Agricultural and Urban Water Supply Benefits versus maximum storage volumes. Figures SA-31 and SA-35 display plots of net increases in Agricultural and Urban Water Supply Benefits. The wide range of benefits seen in these plots between operation conditions for any given maximum reservoir volume confirms that operation conditions must be more thoroughly defined before the maximum storage volume of south of Delta storage facilities can be optimized.

Figures SA-26 and SA-31 show that maximum 71-Year Average Annual Agricultural and Urban Water Supply Benefits are achieved under Condition C (Expanded Banks Pumping Plant Capacity -- Normal Period Supply Operation). Under this operating condition, 71-Year Average Annual Agricultural and Urban Water Supply Benefits continues to increase with diminishing incremental benefit throughout the range of maximum storage volumes evaluated. With a maximum storage volume of 3.0 maf, the largest maximum storage volume evaluated, a net increase of 308 taf is observed in 71-Year Average Annual Agricultural and Urban Water Supply Benefits. About 75 percent of this net benefit, a 232 taf increase in 71-Year Average Annual Agricultural and Urban Water Supply Benefits, is achieved with a maximum storage volume of only 1.0 maf.

Under Condition A (Existing Banks Pumping Plant Capacity -- Normal Period Supply Operation), 71-Year Average Annual Agricultural and Urban Water Supply Benefits increases through about 2.0 maf maximum storage capacity, but with smaller incremental gains in comparison to Condition C. Net 71-Year Average Annual Agricultural and Urban Water Supply Benefits remain constant between 2.0 and 3.0 maf maximum storage capacity. With a maximum storage volume of 2.0 maf, a net increase of 75 taf occurs in 71-Year Average Annual Agricultural and Urban Water Supply Benefits. About 79 percent of this net benefit, or 59 taf is achieved with a 500 taf maximum storage volume.

Figures SA-30 and SA-35 indicate that the largest Minimum Annual Agricultural and Urban Water Supply Benefits is achieved under Condition D (Expanded Banks Pumping Plant Capacity -- Dry Period Supply Operation). Under this operating condition, Minimum Annual Agricultural and Urban Water Supply Benefits increases dramatically between maximum storage volumes of 0 and 1.5 maf. Additional net benefits with decreased incremental gains between 1.5 and 3.0 maf. A maximum net benefit of 479 taf in Minimum Annual Agricultural and Urban Water Supply Benefits is observed with a maximum storage volume of 3.0 maf.

About 83 percent of this net benefit, or 397 taf is achieved with a 1.5 maf maximum storage volume.

Under Condition B (Existing Banks Pumping Plant Capacity -- Dry Period Supply Operation), a net increase in Minimum Annual Agricultural and Urban Water Supply Benefits of 228 taf is observed with a maximum storage volume of 1.5 maf. Under Condition B, no significant additional agricultural and urban water supply benefits are achieved with maximum storage volumes larger than 1.5 maf.

Table SA-9

South of Delta Off-Aqueduct Storage
Model Runs for Evaluation of Maximum Reservoir Volume

Run Results Workbook	Evaluation Workbook	Model Run Identifiers	Maximum Reservoir Volume (taf)	Common Assumptions
OUT_SO3.XLS	SA_RV1.XLS	SA200	100	<u>Existing Banks PP Capacity -- Normal Period Supply Operation</u>
		SA201	250	3,500 cfs Inflow/Outflow Capacity
		SA202	500	Existing Banks PP Capacity
		SA203	750	Storage Carryover Factor = 0%
		SA204	1,000	Unmet Demand Target = SWP & CVP
		SA205	1,250	
		SA206	1,500	
		SA207	1,750	
		SA208	2,000	
		SA209	2,500	
		SA210	3,000	
OUT_SO3.XLS	SA_RV2.XLS	SA211	100	<u>Existing Banks PP Capacity -- Dry Period Supply Operation</u>
		SA212	250	3,500 cfs Inflow/Outflow Capacity
		SA213	500	Existing Banks PP Capacity
		SA214	750	Storage Carryover Factor = 50%
		SA215	1,000	Unmet Demand Target = SWP
		SA216	1,250	
		SA217	1,500	
		SA218	1,750	
		SA219	2,000	
		SA220	2,500	
		SA221	3,000	
OUT_SO3.XLS	SA_RV3.XLS	SA222	100	<u>Expanded Banks PP Capacity -- Normal Period Supply Operation</u>
		SA223	250	3,500 cfs Inflow/Outflow Capacity
		SA224	500	SDI Banks PP Capacity
		SA225	750	Storage Carryover Factor = 0%
		SA226	1,000	Unmet Demand Target = SWP & CVP
		SA227	1,250	
		SA228	1,500	
		SA229	1,750	
		SA230	2,000	
		SA231	2,500	
		SA232	3,000	
OUT_SO3.XLS	SA_RV4.XLS	SA233	100	<u>Expanded Banks PP Capacity -- Dry Period Supply Operation</u>
		SA234	250	3,500 cfs Inflow/Outflow Capacity
		SA235	500	SDI Banks PP Capacity
		SA236	750	Storage Carryover Factor = 50%
		SA237	1,000	Unmet Demand Target = SWP
		SA238	1,250	
		SA239	1,500	
		SA240	1,750	
		SA241	2,000	
		SA242	2,500	
		SA243	3,000	

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Table SA-10

South of Delta Off-Aqueduct Storage
Ag & Urban Water Supply Benefits vs. Maximum Storage Volume
Under Various Operational Conditions[1]

(Values in thousands of acre-feet)

Operation Condition A. Existing Banks PP Capacity -- Normal Period Supply Operation

Run Identifiers:	Base 1	SA200	SA201	SA202	SA203	SA204	SA205	SA206	SA207	SA208	SA209	SA210	Maximum Total Value	Maximum Net Value	Maximum Increase (percent)
Max. Storage Volume (taf)	0	100	250	500	750	1,000	1,250	1,500	1,750	2,000	2,500	3,000			
71-Year Average	5,921	5,945	5,966	5,980	5,985	5,987	5,988	5,990	5,993	5,996	5,996	5,996	5,996	75	1.3%
1928-34 Dry Period Average	3,918	3,919	3,919	3,919	3,919	3,919	3,919	3,919	3,919	3,919	3,919	3,919	3,919	1	0.0%
Dry Year Average	5,374	5,392	5,410	5,427	5,439	5,453	5,468	5,483	5,497	5,510	5,510	5,510	5,510	137	2.5%
Critically Dry Year Average	3,421	3,421	3,421	3,421	3,421	3,421	3,421	3,421	3,421	3,421	3,421	3,421	3,421	0	0.0%
Minimum Annual	2,206	2,206	2,206	2,206	2,206	2,206	2,206	2,206	2,206	2,206	2,206	2,206	2,206	0	0.0%

Operation Condition B. Existing Banks PP Capacity -- Dry Period Supply Operation

Run Identifiers:	Base 1	SA211	SA212	SA213	SA214	SA215	SA216	SA217	SA218	SA219	SA220	SA221	Maximum Total Value	Maximum Net Value	Maximum Increase (percent)
Max. Storage Volume (taf)	0	100	250	500	750	1,000	1,250	1,500	1,750	2,000	2,500	3,000			
71-Year Average	5,921	5,920	5,938	5,953	5,961	5,965	5,967	5,969	5,971	5,973	5,978	5,978	5,978	57	1.0%
1928-34 Dry Period Average	3,918	3,922	3,930	3,941	3,941	3,941	3,941	3,941	3,941	3,941	3,941	3,941	3,941	23	0.6%
Dry Year Average	5,374	5,381	5,412	5,456	5,477	5,491	5,496	5,501	5,509	5,518	5,529	5,529	5,529	155	2.9%
Critically Dry Year Average	3,421	3,424	3,437	3,457	3,474	3,483	3,494	3,511	3,519	3,526	3,548	3,548	3,548	127	3.7%
Minimum Annual	2,206	2,211	2,240	2,296	2,354	2,373	2,404	2,455	2,457	2,457	2,457	2,457	2,457	250	11.3%

Operation Condition C. Expanded Banks PP Capacity -- Normal Period Supply Operation

Run Identifiers:	Base 2	SA222	SA223	SA224	SA225	SA226	SA227	SA228	SA229	SA230	SA231	SA232	Maximum Total Value	Maximum Net Value	Maximum Increase (percent)
Max. Storage Volume (taf)	0	100	250	500	750	1,000	1,250	1,500	1,750	2,000	2,500	3,000			
71-Year Average	6,169	6,221	6,276	6,340	6,377	6,401	6,416	6,431	6,443	6,455	6,467	6,477	6,477	308	5.0%
1928-34 Dry Period Average	4,033	4,062	4,086	4,118	4,118	4,118	4,118	4,118	4,118	4,118	4,118	4,118	4,118	85	2.1%
Dry Year Average	5,635	5,681	5,729	5,758	5,793	5,848	5,909	5,971	6,005	6,034	6,042	6,071	6,071	436	7.7%
Critically Dry Year Average	3,480	3,486	3,494	3,501	3,521	3,543	3,564	3,571	3,571	3,571	3,590	3,628	3,628	148	4.3%
Minimum Annual	2,184	2,184	2,184	2,184	2,184	2,184	2,184	2,184	2,184	2,184	2,184	2,494	2,494	310	14.2%

Operation Condition D. Expanded Banks PP Capacity -- Dry Period Supply Operation

Run Identifiers:	Base 2	SA233	SA234	SA235	SA236	SA237	SA238	SA239	SA240	SA241	SA242	SA243	Maximum Total Value	Maximum Net Value	Maximum Increase (percent)
Max. Storage Volume (taf)	0	100	250	500	750	1,000	1,250	1,500	1,750	2,000	2,500	3,000			
71-Year Average	6,169	6,159	6,198	6,239	6,262	6,278	6,293	6,307	6,316	6,323	6,345	6,361	6,361	192	3.1%
1928-34 Dry Period Average	4,033	4,042	4,076	4,108	4,140	4,172	4,179	4,179	4,179	4,179	4,179	4,179	4,179	145	3.6%
Dry Year Average	5,635	5,656	5,717	5,777	5,820	5,864	5,910	5,945	5,966	5,995	6,047	6,072	6,072	436	7.7%
Critically Dry Year Average	3,480	3,485	3,505	3,544	3,576	3,614	3,641	3,666	3,691	3,716	3,768	3,819	3,819	339	9.8%
Minimum Annual	2,184	2,194	2,227	2,284	2,343	2,403	2,465	2,581	2,594	2,607	2,634	2,663	2,663	479	21.9%

[1]See Table SE-9 for description of operational conditions.

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Table SA-11

South of Delta Off-Aqueduct Storage
Net Increase in Ag &Urban Water Supply Benefits vs. Maximum Storage Volume
Under Various Operational Conditions[1]

(Values in thousands of acre-feet)

Operation Condition A. Existing Banks PP Capacity -- Normal Period Supply Operation											
Run Identifiers:	SA200	SA201	SA202	SA203	SA204	SA205	SA206	SA207	SA208	SA209	SA210
Max. Storage Volume (taf)	100	250	500	750	1,000	1,250	1,500	1,750	2,000	2,500	3,000
71-Year Average	24	45	59	64	66	67	69	72	75	75	75
1928-34 Dry Period Average	1	1	1	1	1	1	1	1	1	1	1
Dry Year Average	18	37	53	65	80	94	109	124	137	137	137
Critically Dry Year Average	0	0	0	0	0	0	0	0	0	0	0
Minimum Annual	0	0	0	0	0	0	0	0	0	0	0

Operation Condition B. Existing Banks PP Capacity -- Dry Period Supply Operation											
Run Identifiers:	SA211	SA212	SA213	SA214	SA215	SA216	SA217	SA218	SA219	SA220	SA221
Max. Storage Volume (taf)	100	250	500	750	1,000	1,250	1,500	1,750	2,000	2,500	3,000
71-Year Average	-1	17	32	40	44	46	48	50	52	57	57
1928-34 Dry Period Average	4	12	23	23	23	23	23	23	23	23	23
Dry Year Average	7	38	83	103	118	122	128	136	144	155	155
Critically Dry Year Average	4	16	36	53	62	74	90	98	105	127	127
Minimum Annual	5	34	89	147	167	197	248	250	250	250	250

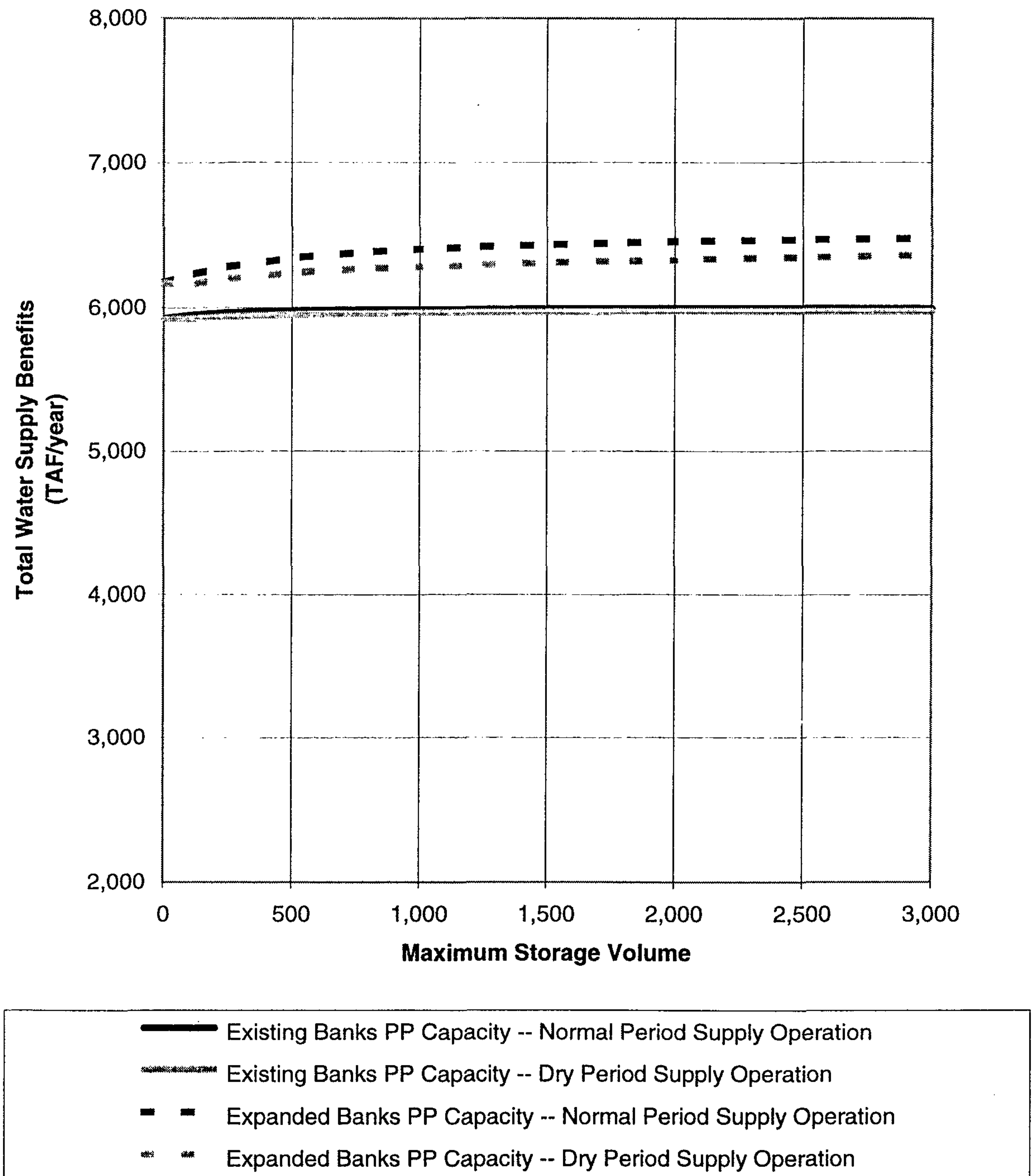
Operation Condition C. Expanded Banks PP Capacity -- Normal Period Supply Operation											
Run Identifiers:	SA222	SA223	SA224	SA225	SA226	SA227	SA228	SA229	SA230	SA231	SA232
Max. Storage Volume (taf)	100	250	500	750	1,000	1,250	1,500	1,750	2,000	2,500	3,000
71-Year Average	52	107	171	208	232	247	262	274	286	298	308
1928-34 Dry Period Average	28	52	85	85	85	85	85	85	85	85	85
Dry Year Average	45	93	123	158	213	274	335	370	399	407	436
Critically Dry Year Average	6	15	21	42	63	84	91	91	91	110	148
Minimum Annual	0	0	0	0	0	0	0	0	0	0	310

Operation Condition D. Expanded Banks PP Capacity -- Dry Period Supply Operation											
Run Identifiers:	SA233	SA234	SA235	SA236	SA237	SA238	SA239	SA240	SA241	SA242	SA243
Max. Storage Volume (taf)	100	250	500	750	1,000	1,250	1,500	1,750	2,000	2,500	3,000
71-Year Average	-10	28	69	93	109	124	138	146	154	176	192
1928-34 Dry Period Average	9	43	75	107	138	145	145	145	145	145	145
Dry Year Average	20	82	142	185	229	274	310	330	360	411	436
Critically Dry Year Average	5	26	64	97	134	161	186	211	237	288	339
Minimum Annual	10	43	100	159	219	281	397	410	423	450	479

[1]See Table SE-9 for description of operational conditions.

Figure SA-26

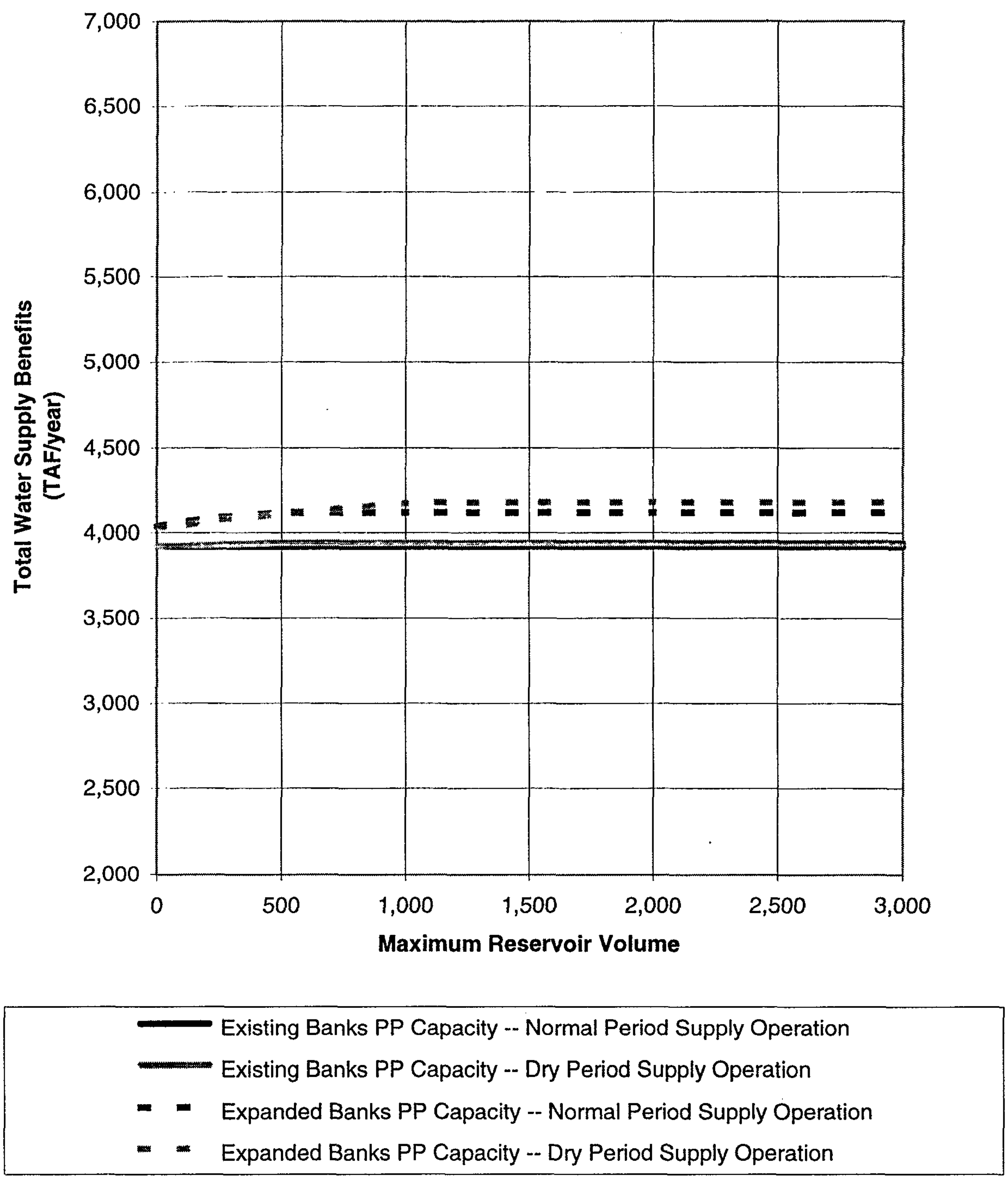
South of Delta Off-Aqueduct Storage
71-Year Average Ag & Urban Water Supply Benefits
versus Maximum Storage Volume



SA_RVSM.XLS: 71-Yr Avg Chart

Figure SA-27

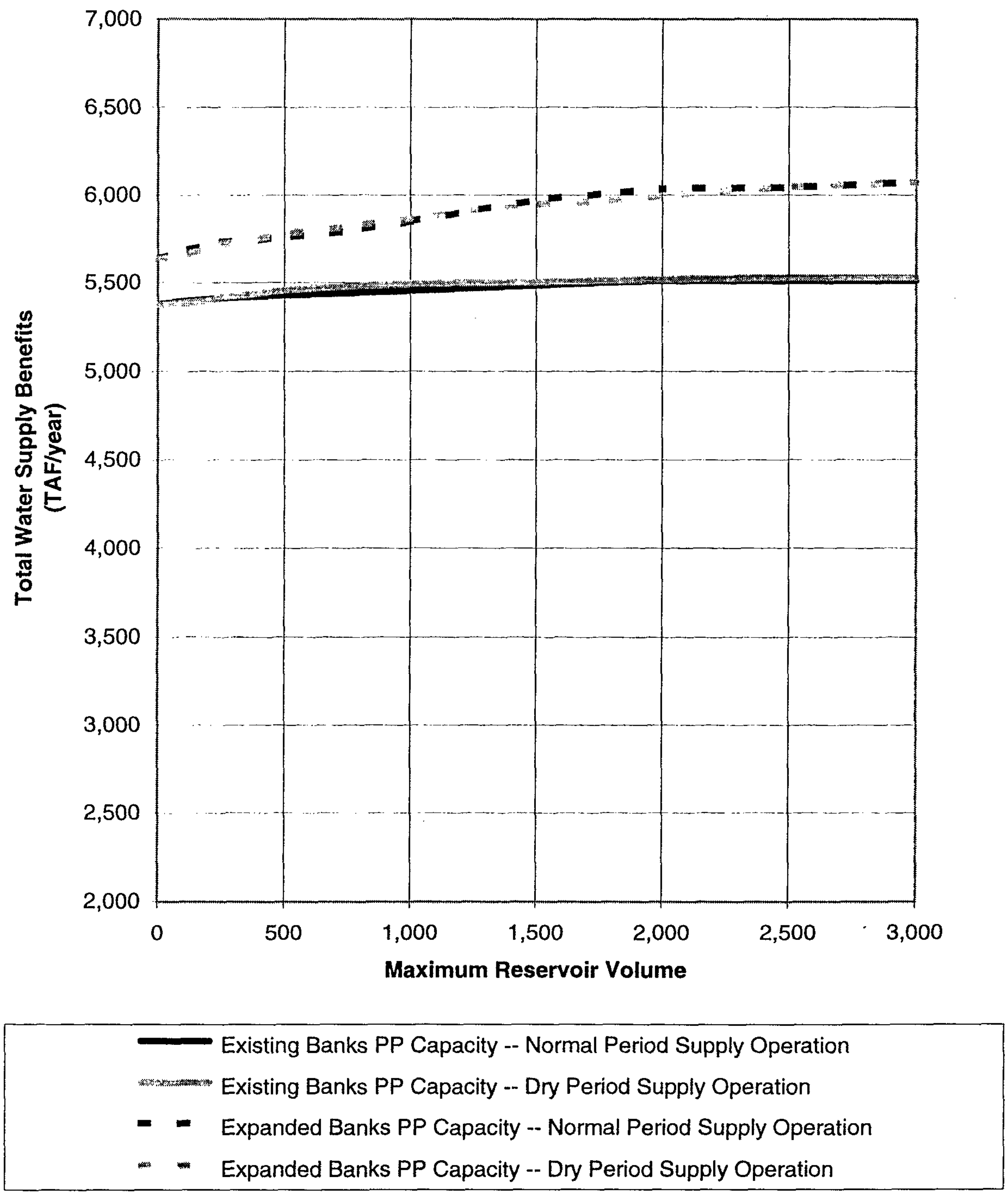
South of Delta Off-Aqueduct Storage
1928-34 Dry Period Annual Average Ag & Urban Water Supply Benefits versus Maximum Storage Volume



SA_RVSM.XLS: 1928-34 Chart

Figure SA-28

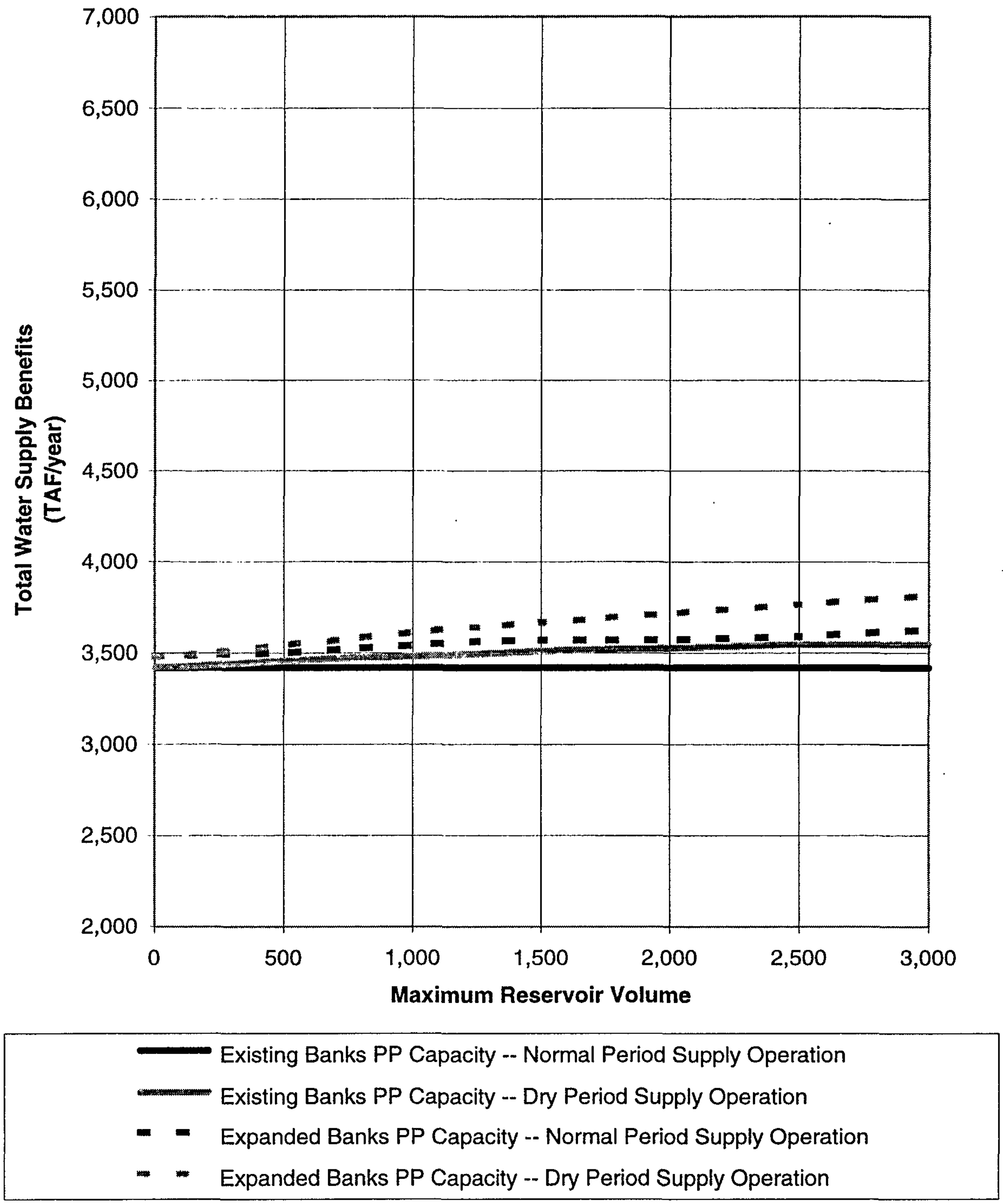
South of Delta Off-Aqueduct Storage
Dry Year Average Ag & Urban Water Supply Benefits
versus Maximum Storage Volume



SA_RVSM.XLS: Dry Years Chart

Figure SA-29

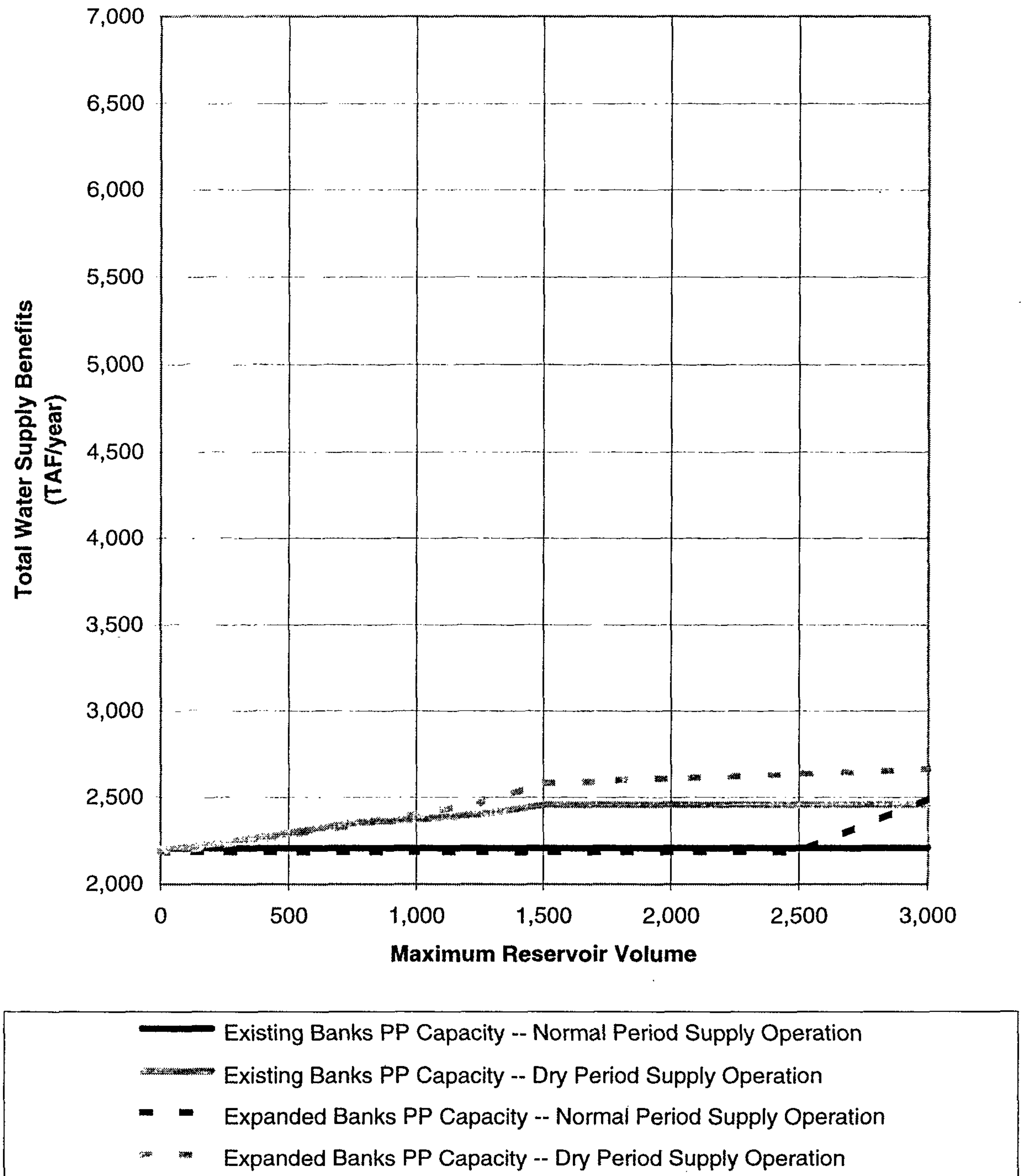
South of Delta Off-Aqueduct Storage
Critical Year Average Ag & Urban Water Supply Benefits
versus Maximum Storage Volume



SA_RVSM.XLS: Crit Years Chart

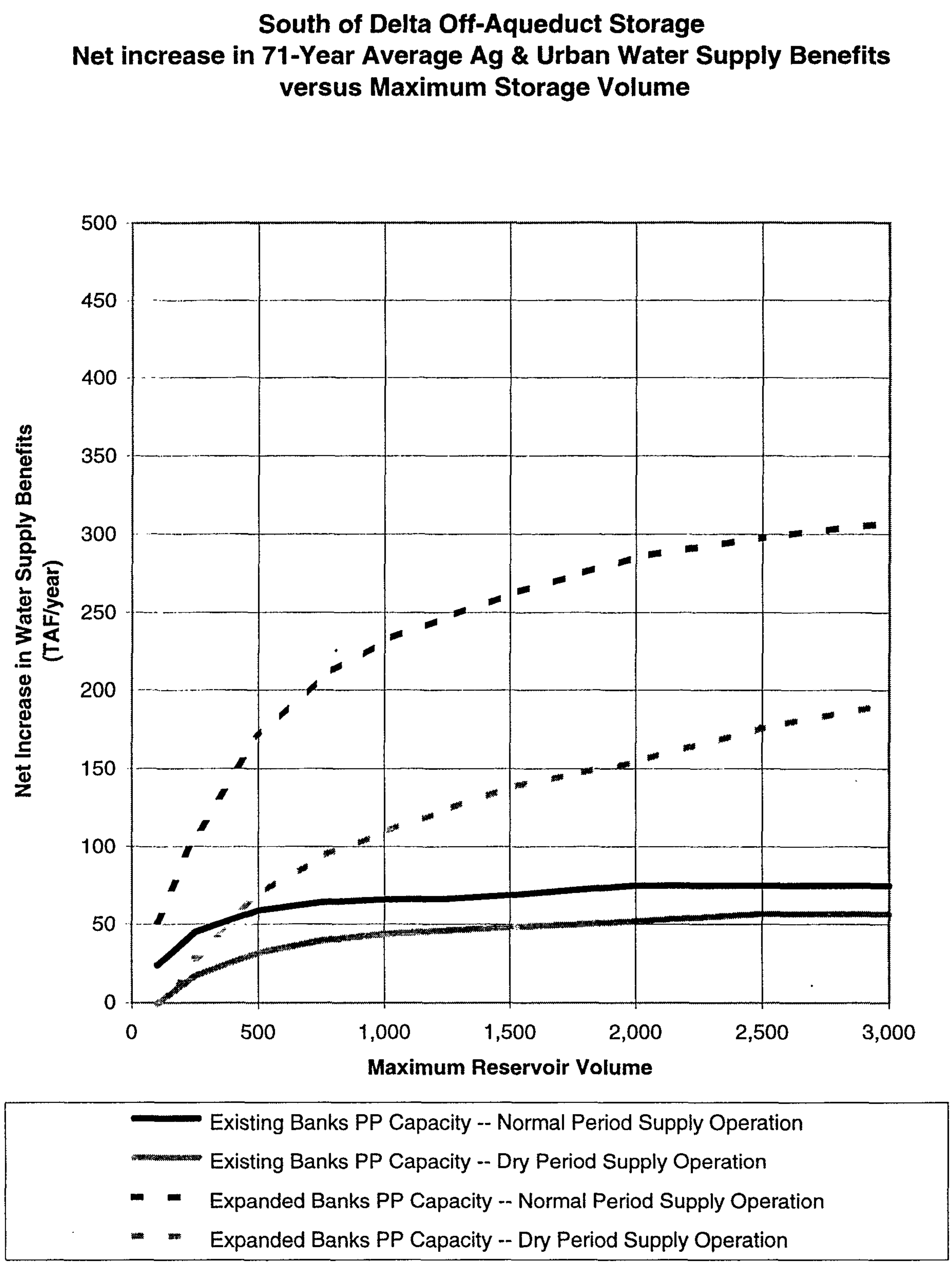
Figure SA-30

South of Delta Off-Aqueduct Storage
Minimum Annual Ag & Urban Water Supply Benefits
versus Maximum Storage Volume



SA_RVSM.XLS: Min Annual Chart

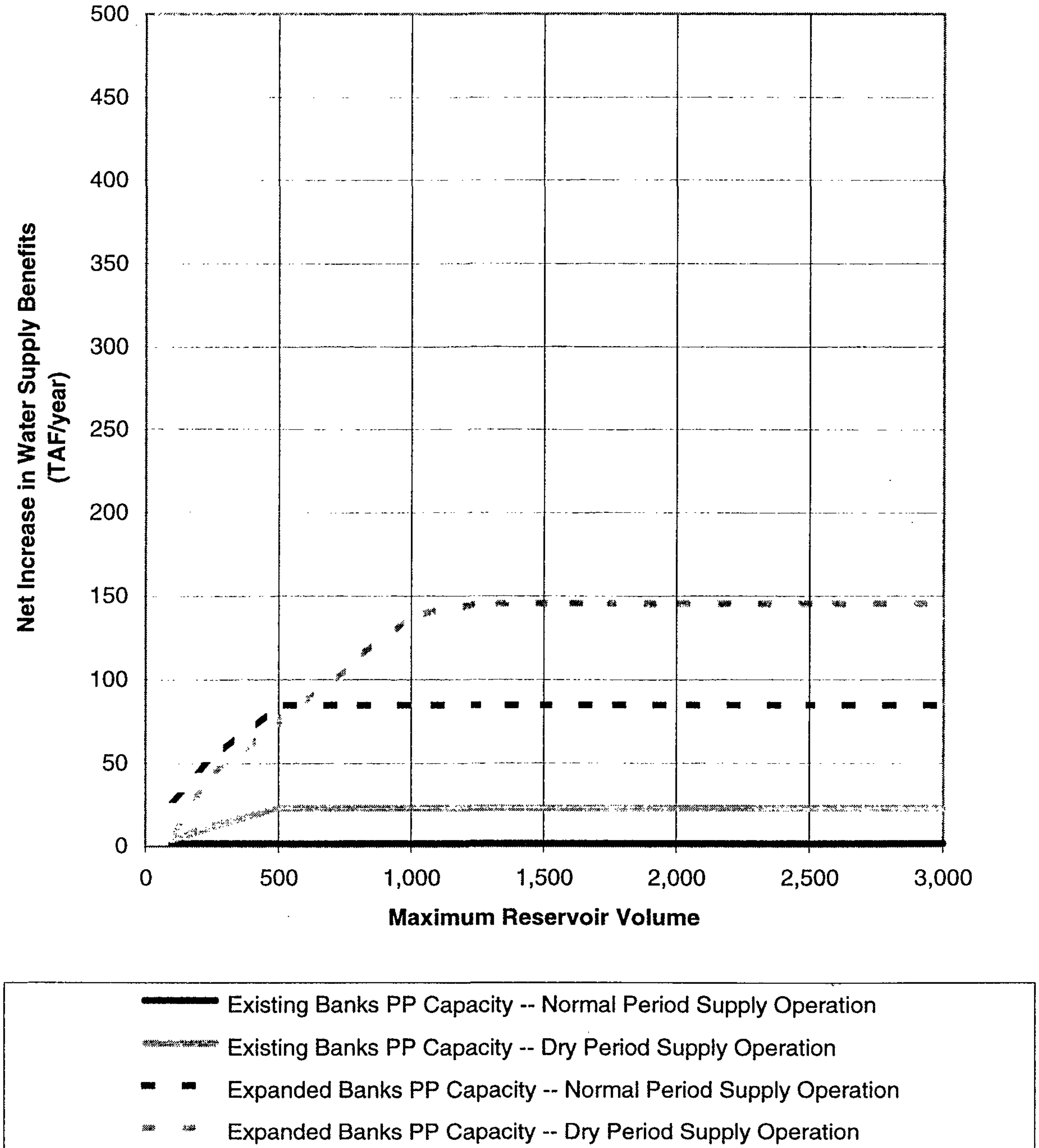
Figure SA-31



SA_RVSM.XLS: Net 71-Yr Avg Chart

Figure SA-32

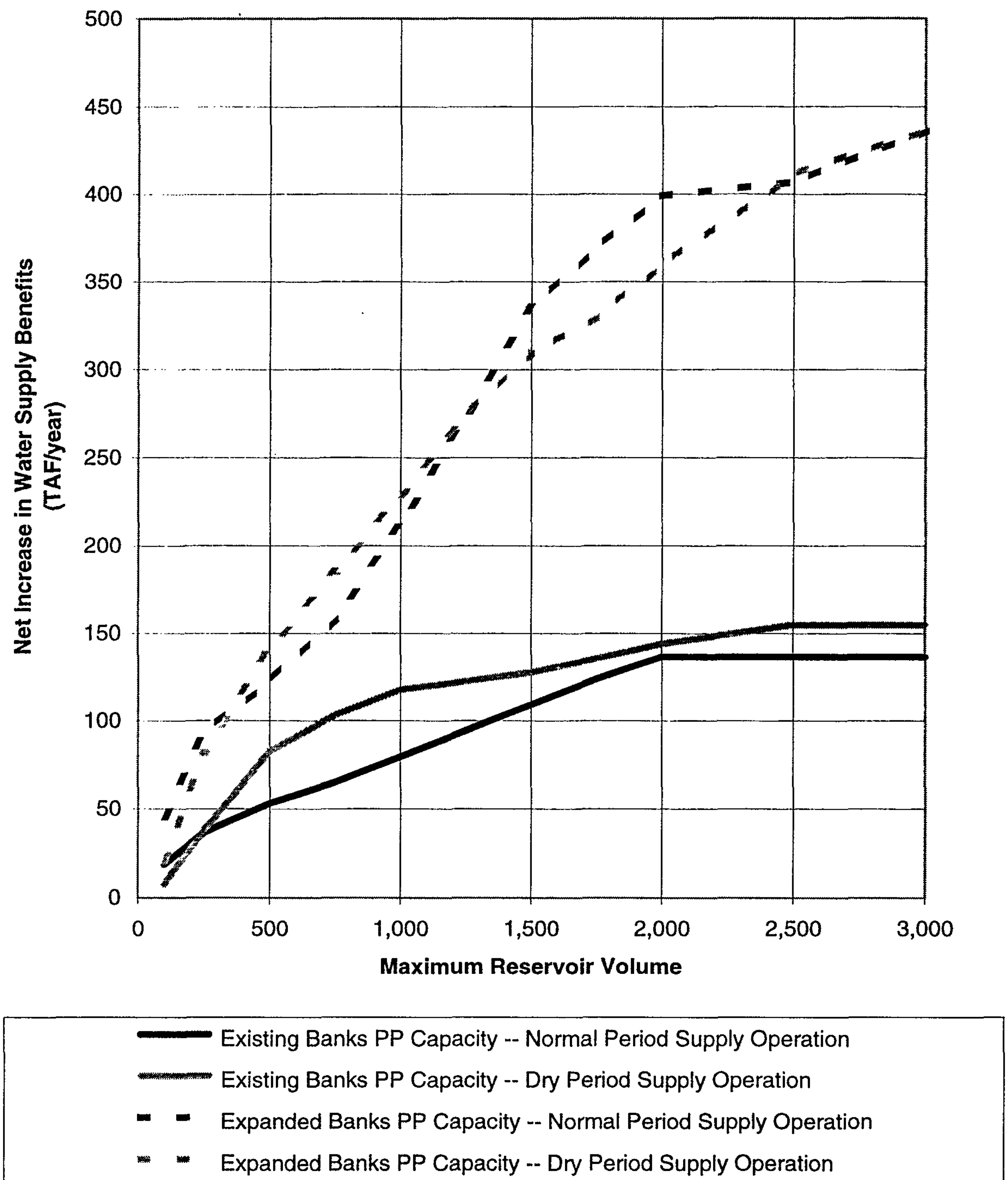
South of Delta Off-Aqueduct Storage
Net Increase in 1928-34 Dry Period Annual Average Ag & Urban Water Supply Benefits versus Maximum Storage Volume



SA_RVSM.XLS: Net 1928-34 Chart

Figure SA-33

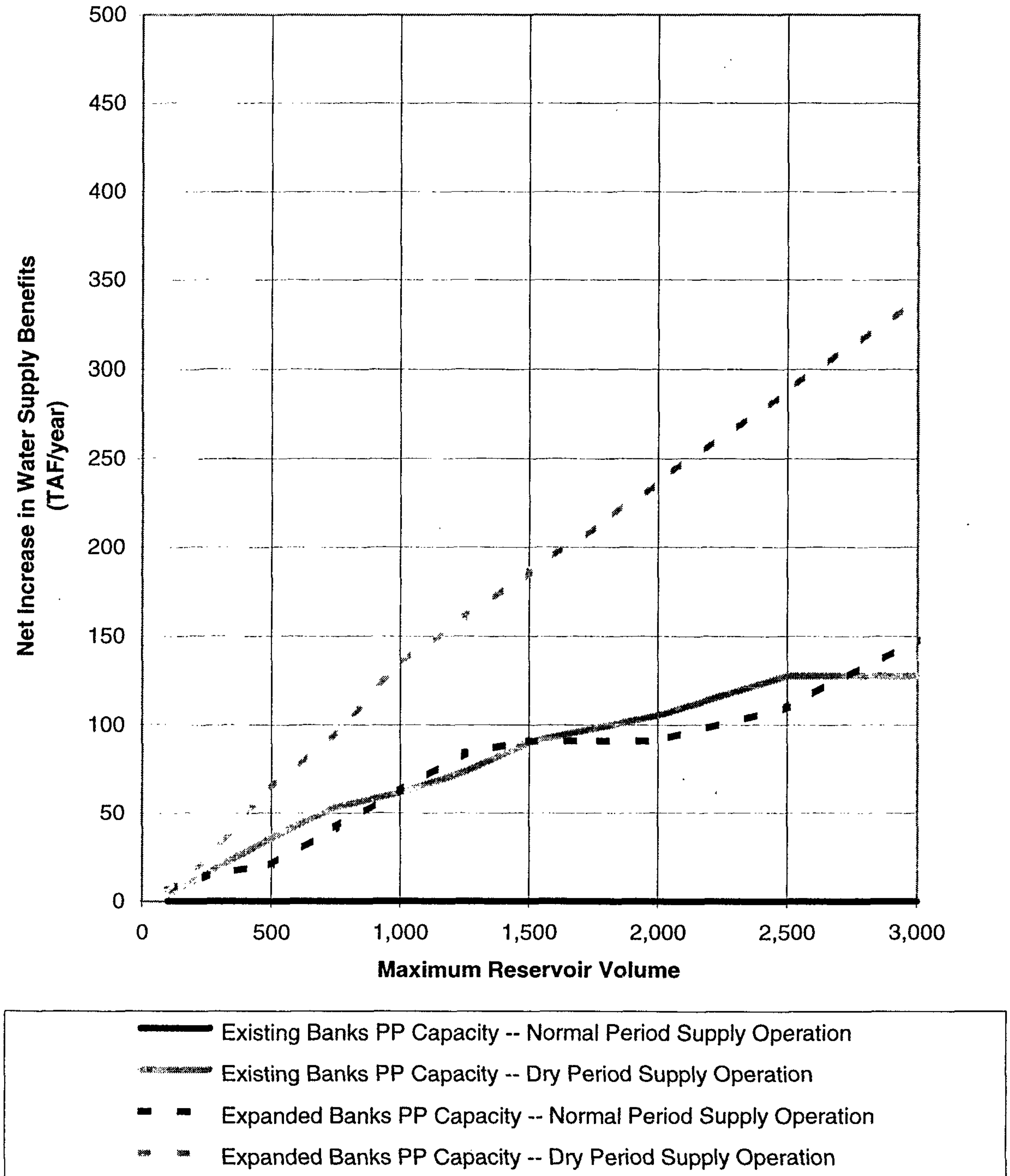
South of Delta Off-Aqueduct Storage
Net Increase in Dry Year Average Ag & Urban Water Supply Benefits
versus Maximum Storage Volume



SA_RVSM.XLS: Net Dry Years Chart

Figure SA-34

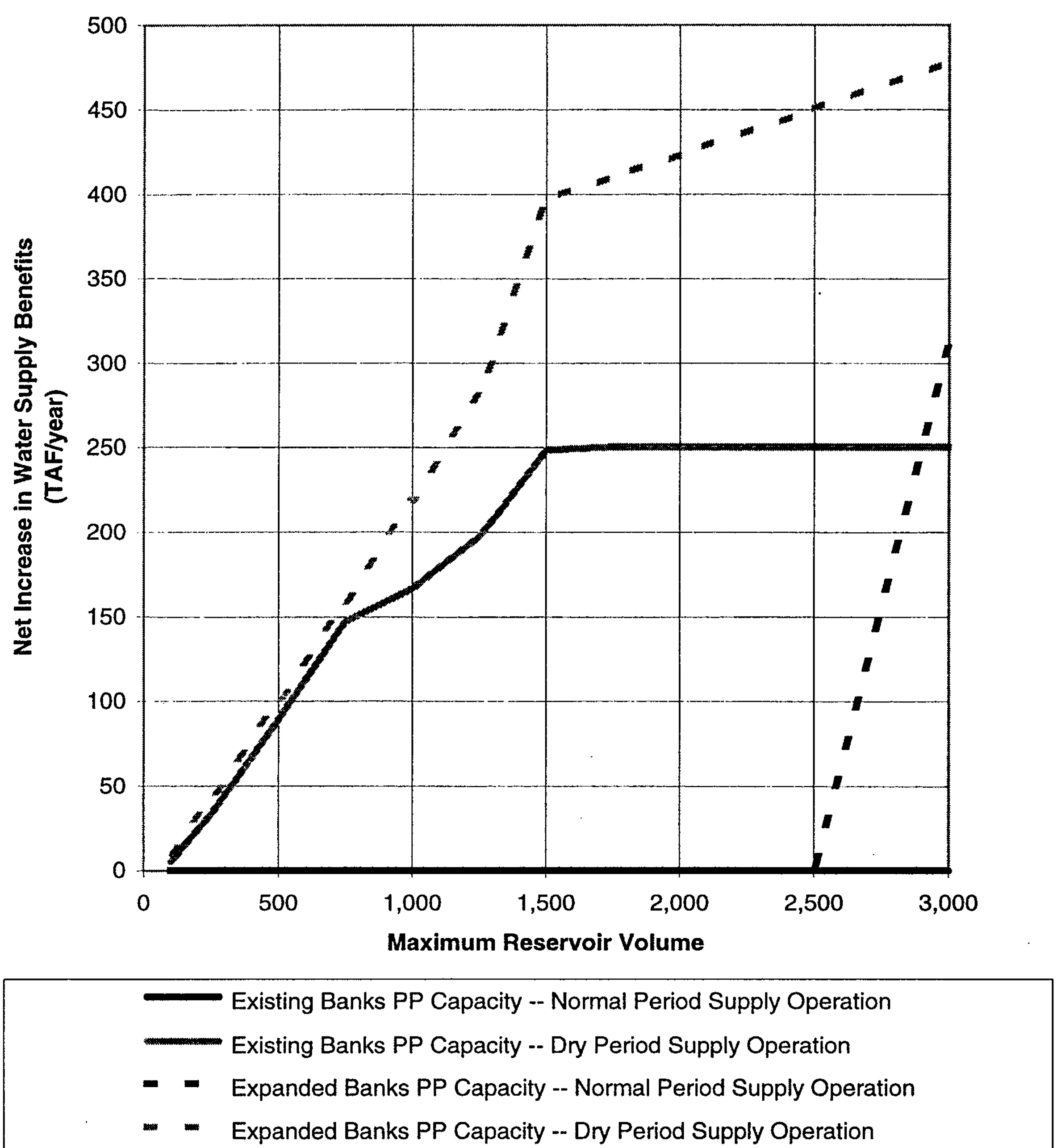
South of Delta Off-Aqueduct Storage
Net Increase in Critical Year Average Ag & Urban Water Supply Benefits
versus Maximum Storage Volume



SA_RVSM.XLS: Net Crit Years Chart

Figure SA-35

South of Delta Off-Aqueduct Storage
Net Increase in Minimum Annual Ag & Urban Water Supply Benefits
versus Maximum Storage Volume



SA_RVSM.XLS: Net Min Annual Chart